New approaches for determining solubility of volatile liquid chemicals

Birch, Heidi; Trac, Ngoc Lam; Mayer, Philipp

Published in:
SETAC Europe 28th Annual Meeting - Abstract book

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

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This book compiles the abstracts from the platform and poster session presentations at the 28th Annual Meeting of the Society of Environmental Toxicology and Chemistry - Europe (SETAC Europe), conducted at the Rome Convention Centre La Nuvola, Rome, Italy, from 13 – 17 May 2018.
The abstracts are reproduced as submitted by the author and accepted by the Scientific Committee. They appear in order of abstract code and alphabetical order per presentation type. The poster spotlight abstracts are included in the list of poster abstracts. The presenting author of each abstract is underlined.

SETAC Europe Office
Avenue de la Toison d’Or 67
B-1060 Brussels
Belgium
T +32 2 772 72 81
F +32 2 770 53 86
setaceu@setac.org
setac.org

SOCIETY OF ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY
In the 1970s, no forum existed for interdisciplinary communication among environmental scientists, biologists, chemists, toxicologists, managers, engineers or others interested in environmental issues. The Society of Environmental Toxicology and Chemistry (SETAC) was founded in North America in 1979 to fill the void, and quickly saw dynamic growth in the Society's membership, meeting attendance and publications.

A unique strength of SETAC is its commitment to balance the scientific interests of government, academia and business. The Society by-laws mandate equal representation from these three sectors for officers of the World Council and Geographic Unit Boards of Directors and Councils, and in the composition of committees and other society activities. The proportion of members from each of the three sectors has remained nearly equal over the years.

The Society is concerned about global environmental issues. Its members are committed to Environmental Quality Through Science®, to timely and effective communication of
research, and to interactions among professionals so that enhanced knowledge and increased personal exchanges occur. Therefore, SETAC publishes two globally esteemed scientific journals and convenes annual meetings around the world, showcasing cutting-edge science in poster and platform presentations. Because of its multidisciplinary approach, the scope of the science of SETAC is broader in concept and application than that of many other societies.

SETAC’s growth is reflected in the founding of geographic units around the world. SETAC Europe was established in 1989 as an independent organisation, followed by SETAC Asia-Pacific in 1997 and SETAC Latin America in 1999. In 2002, the four existing organisations joined together under the governance of the SETAC World Council. SETAC Africa is the most recent geographic unit, which was adopted in 2012. As evidence of international acceptance of the SETAC model and of the great interest at the local level, regional chapters and branches have emerged in a number of countries.

SETAC publishes two journals: *Environmental Toxicology and Chemistry* (ET&C) and *Integrated Environmental Assessment and Management* (IEAM). Environmental Toxicology and Chemistry is dedicated to furthering scientific knowledge and disseminating information on environmental toxicology and chemistry, including the application of these sciences to risk assessment. Integrated Environmental Assessment and Management focuses on the application of science in environmental decision-making, regulation, and management, including aspects of policy and law, and the development of scientifically sound approaches to environmental problem solving. Together, these journals provide a forum for professionals in academia, business, government, and other segments of society involved in the use, protection, and management of the environment for the enhancement of ecological health and human welfare.

SETAC books provide timely in-depth reviews and critical appraisals on scientific subjects relevant to understanding a wide range of contemporary topics pertaining to the environment. These include any aspect of environmental chemistry, toxicology, risk assessment, risk management, or environmental policy.

SETAC has two administrative offices, in Pensacola, Florida, USA, established in 1992, and in Brussels, Belgium, established in 1993.
Keynote abstracts

Keynote Sunday
Responsible Research and Innovation (RRI) - a Path towards Sustainability? Bernhard Url, University of Bergen, Centre for the Study of the Sciences and the Humanities, Norway

Responsible Research and Innovation (RRI) is a cross-cutting principle of EU’s research funding programme “Horizon 2020”. Indeed, in Rome 2014, scientists and policy-makers jointly produced the “Rome Declaration on RRI in Europe”; that states that “excellence today is about more than ground-breaking discoveries – it includes openness, responsibility and the co-production of knowledge”. The principle of RRI acknowledges that civil society is entitled to “speak back” to science and help shape the knowledge and technology of tomorrow in an ethically acceptable and sustainable direction.

What does RRI entail in practice, for researchers, innovators and policy-makers? How could RRI principles, indicators and practices help to pick up more early warnings to avoid costly late lessons from unfortunate impacts of science and technology? The lecture will present the conceptual basis of EU’s RRI policy. Specifically, a full appreciation of RRI depends on a theoretical understanding not only of risk, but also of decision-making under uncertainty, ignorance and indeterminacy.

Keynote Monday
Food Safety in a Complex Changing World
Bernhard Url, EFSA, Italy

EFSA provides independent scientific advice on all matters related with food and feed with a direct or indirect impact on human, plant and animal health. Effects on the environment are also considered as they may pose an indirect risk to food and feed. EFSA takes into account environmental risk assessment in its assessments of the application of plant protection products, the deliberate release into the environment of GMOs and the use of certain substances in food and feed (e.g. feed additives). EFSA also assesses the environmental risks related to the entry and spread of invasive alien species harmful for plant health.

EFSA is looking into the future, keeping up with a rapidly evolving and globalised world, characterised by dramatic environmental and other global changes (e.g. economic, political social, and technological) and an exponential growth and availability of data. These set new opportunities and challenges to the assessment of risks to both the environment and food safety and can drive their (re)emergence. In this context, EFSA is reviewing the methodologies for risk assessment and for the identification of emerging risks within its remit.

Predictive modelling tools based on holistic approaches for environmental risk assessment in realistic landscapes and under different scenarios of multiple stressors are being developed. Approaches considering the complex interactions and dynamics between the different food system actors, their behaviour and external drivers are proposed as tools useful for long term anticipation of emerging risks. Expert knowledge elicitation, horizon scanning, and crowdsourcing are being explored as tools to broaden participation, strengthen engagement of all relevant stakeholders and manage interconnectivity, in application of principles of resilience thinking.

Environmental quality and food safety are strongly intertwined. They need to be considered together when aiming toward the achievement of sustainable development goals. Consistent approaches for scientific assessment and data management need to be developed, integrating also societal, technological and economic drivers to effectively cope with the dramatic global changes and the data revolution we are observing.

Keynote Tuesday
Innovative Research Issues in Environmental Mutagenesis
Eugenio Dogliotti, Istituto Superiore di Sanità, Department of Environment and Health, Italy

During the 1920s, mutation research was put on a firm basis by H. J. Muller, who developed the concept of “mutation rate” and devised quantitative techniques for its measurement. These techniques allowed the discovery of the mutagenic action of ionizing radiation and paved the way for the pioneering work of C. Auerbach on chemical testing, starting with mustard gas. Since that time the recognition of the multitude of possible sources of mutagenic insults promoted the development of the science of environmental mutagenesis. Today the mechanisms by which chemicals induce mutation and the role of genetic susceptibility in the response to environmental mutagens have been largely explored. Moreover, a battery of test methods is available for regulatory purposes. What are the current challenges in environmental mutagenesis? New techniques for mutation research have been developed. The “omics” techniques such as whole genome sequencing, epigenetic profiling, transcriptomics, proteomics and metabolomics have provided a snapshot on the effects of genetic polymorphisms, gene regulation, protein synthesis and stability, metabolic pathways in the control of cell function. This presentation will describe: 1) the successful identification of the mutagenic environmental agents underlying certain types of cancer by using whole genome sequencing; (ii) the evidence that epigenetic alterations mediate toxicity from environmental chemicals and, (iii) the use of the exposome approach, that comprises all environmental exposures that a person experiences from conception throughout the life course, to unravel complex gene environment interactions that affect disease risk.

Keynote Wednesday
The Environmental Dimension of Antimicrobial Resistance: Assessing and Managing the Risks of Anti-infectives
Jason Snape, AstraZeneca Global Safety, Health and Environment, UK

Antibiotics are vital in the treatment of infectious disease in both livestock and human health and they are entering the environment continuously. In freshwater, antibiotics can reach concentrations up to mg/L, but more commonly they occur in the low to sub μg/L range. They selectively target bacteria and thus there is an increased likelihood for impacts on environmental bacteria populations at levels well below that for effects on aquatic vertebrates. However, current environmental risk assessment (ERA) frameworks of antibiotics, as required by the European Medicines Agency guidelines 2006, adopts the use of one species of cyano bacterium only to represent all bacterial diversity. The activated sludge respiration inhibition test (ASRIT), used to identify risk to microorganisms in sewage treatment plants has also been proven to be insensitive for antibiotics. Thus, there is concern that the ERA for antibiotics does not fully consider their potential impacts on microbial community structure, function and resilience. In addition to the risk posed to ecosystem function there is a global concern on antimicrobial resistance (AMR) development and the associated risk to human health. It has been proposed that the risk of AMR development in the natural environment should be included in ERA but there is currently no standard experimental methodology or framework to address this. Recently, a theoretical approach that makes use of minimum inhibitory concentrations (MIC) of clinically relevant bacteria (CRB; using the European Committee on Antimicrobial Susceptibility Testing (EUCAST) database) has been proposed to predict no effect concentrations (PNEC) for AMR development (PNECR). To help define science-based protection goals for antibiotics for use in a prospective ERA frameworks and to define safe discharge concentrations for antibiotic production and patient use this presentation will review the publicly available aquatic ecotoxicity data for antibiotics to assess the following: 1) the relative sensitivity of commonly used taxa in aquatic ecotoxicity to antibiotics; 2) the value of extending the toxicity testing to a more diverse range of bacteria species and; 3) how a PNEC relates to the PNEC derived for surface waters (PNECSW) using standard ecotoxicity testing. This presentation will describe (i) the output of this analysis of protection goal data and (ii) how the wider pharmaceutical industry are addressing concerns with antibiotic residues associated with manufacturing operations.
Platform Abstracts

Modelling and monitoring of pesticides fate and exposure in a regulatory context (I)

1 The SETAC DRAW workshops - aims, approaches and progress to date

In order to develop a more complete understanding of spray drift to improve the regulatory basis for representation in risk assessments, a set of SETAC workshops known as DRAW (Drift Risk Assessment Workshops) are underway to facilitate a range of efforts: Assemble and interpret a database of the spray drift trials for boom sprayers; Develop a programme of trials to more fully characterise drift influences; Use this information to develop proposals for standardized protocols for drift characterization in the field Develop an enhanced role for mathematical modelling as a higher tier risk assessment option; and Expand and reinforce the toolbox of regulatory risk mitigation measures. This presentation will focus upon: Database development and study design The workshop database currently comprises 56,001 data points from a wide range of studies, providing a rich, complex basis for supporting a range of different research efforts. Beyond the data, the variation in study designs and the consequent difficulties with interpretation there is a clear motivation to develop a more detailed and tightly defined protocol to support future research efforts. This presentation will summarise the database and efforts to develop and test a protocol to support further research efforts. Modelling Options for developing an expanded role for modelling of drift profiles have focussed upon evaluations of two models that have been used within a regulatory context in the EU: IDEFICS and the SSAU Arable Crop Spray Drift Model. This presentation will report on model assessment efforts, potential future improvements in process representation and consider options for regulatory scenario development. Flexibility in risk mitigation An earlier workshop (SETAC MAGPIE) compiled a toolbox of risk mitigation measures in use in Europe and recommended development of communication tools to support broader and more effective implementation and encourage certification and testing harmonisation. This presentation will summarise the efforts underway in SETAC DRAW to realise these objectives through the creation of a platform to support exchange on scientific, technical, professional, and legislative or regulatory aspects of the toolbox, to further develop its accuracy and effectiveness (https://www.spraydriftmitigation.info/).

2 Plant uptake in regulatory environmental exposure assessment: Refined modelling based on experimental data
C. Schriever, BASF SE; Z. Guo, Bayer AG Crop Science Division; M. Lamshoef, Bayer CropScience AG / R&D; M. Reitz, H. Resseler, Syngenta AGro GmbH; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; P. Sweeney, Syngenta; P. Volz, BASF SE; S. Webb, Syngenta Ltd; B. Zillgents, Dupont GmbH

A novel study design to determine plant uptake of chemicals for environmental fate modelling was developed and tested in a tiered approach. Ten laboratory organizations with different levels of experience with uptake testing participated in a round robin test and studied uptake of [14C]-1,2,4-triazole by wheat plants. Afterwards, uptake of ten radiolabelled chemicals with various properties was investigated in two laboratories. The findings showed acceptable inter-laboratory variability and proved the applicability of the design to various compound/crop combinations. Experimental Transpiration Stream Concentration Factor (TSCF) values were higher than calculated values, implying that the equation of Briggs et al. (1982) underestimates plant uptake of compounds with logKow values of less than 2. Results obtained with this study type are suggested to be used for regulatory environmental exposure assessments. These schemes are usually based on a tiered approach, where modelling with refined model parameters is one of the higher tier options. One example is the plant uptake factor that is considered e.g. in the course of the learning assessment according to FOCUS Groundwater. Consideration of plant uptake (dissolved compound mass is taken up into plants with the soil porewater) decreases compound mass in soil and can lead to more realistic predicted environmental concentrations. Recent guidance proposes a default uptake factor of 0 for modelling and suggests two refinement options. A TSCF is calculated from the FOCUS methodology and a substance-specific TSCF value from “uptake experiments with appropriate and agreed set-up to be developed” (EFSA, 2013; EU Com, 2014). The presented study design was explicitly developed to address the need identified by EFSA and was based on suggestions from the EUregPuf workshop (York, 2015) where participants from academia, authorities and industry met to establish an up to date understanding of plant uptake science. Lessons learned from the testing and continuous exchange with academia and authorities facilitated optimisation of the study design. The current version of the study design is considered appropriate to produce reliable data on plant uptake to be used as input for refined exposure modelling. An explicit guidance, however, on how to integrate the requested study design into the regulatory process is still lacking.

3 Work of a SETAC Group to Develop the Scientific Basis for Guidance for Regulator Groundwater Monitoring of Crop Protection Products and their metabolites in Europe
R.L. Joner, Bayer Crop Science Division / Environmental Safety; A. Gimsing, The Danish Environmental Protection Agency / Pesticides and Genetotechnology; J. Agert, Bayer CropScience AG / Environmental Safety; N. Baran, BRGM; A. Bongaerts, BASF SE; F. Ferrando, Syngenta; L. Hammond, Health and Safety Executive / Environmental Fate; F. Hegler, Dr. Knoell Consult; W. Koenig, UBA Umweltbundesamt; J. Kreuger, Swedish University of Agricultural Science / Centre for Chemical Pesticides; T. Van der Linden, RIVM / ENVIRONMENTAL QUALITY; D. Liss, SGS Institut Fresenius GmbH / Agro; L. Lotseau, Syngenta; A. Massey, Health and Safety Executive; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; L. Monozzon, SCE; A. Newcombe, ARCADIS US Inc; L. Padovani, European Food Safety Authority (EFSA); A. Poot, Cbg; G.L. Reeves, Dow AgroSciences Ltd; S. Reichenberger, DR. KNOELL CONSULT GmbH; A.E. Rosenbom, Geological Survey of Denmark and Greenland / Geochemical; H. Staudenmaier, BASF SE / Crop Protection, Environmental Fate; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; A. Swen, AGES; M. Stemmer, Austrian Agency for Health and Food Safety / Institute for Plant Protection Products; W. Tütting, German Federal Office of Consumer Protection and Food Safety; U. Ulrich, University of Kiel

Groundwater monitoring is considered a higher tier assessment in the regulatory groundwater assessment of crop protection products in Europe, but little guidance is available to date on study designs. The SETAC EMAG-Pest GW group (a mixture of regulatory, academic, and industry scientists) in 2015 began developing the scientific basis for guidance for use by regulators and industry scientists. Rigid study designs are not appropriate since the study design needs to be tailored to the specific study objectives and should consider environmental conditions, the properties affecting environmental behaviour of the substance being studied, and site and use conditions. To illustrate how study design can vary, the group has proposed general study designs for seven hypothetical exposure assessment options, ranging from protecting all zones of saturation below the soil surface to only groundwater used to supply drinking water. Designs include recommendations on in-field and edge of field studies, as well as studies focused on catchments and aquifer. Examples of protocol and recommendations on the use of publicly available monitoring data have also been included. Also general recommendations on well installation and sampling procedures have been provided. Methodology has also been developed for assessing the relative vulnerability of agricultural regions and the vulnerability of specific sites for use in study design and site selection. The work of SETAC EMAG-Pest GW is still in progress but the goal is to finish by mid-2018.

4 Effect of the Freundlich exponent on the finite penetration depth in a homogenous Freundlich-SFO leaching system
J. Boesten, Wageningen Environmental Research

After the use of a finite penetration depth in the FOCUS groundwater assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with a single first-order (SFO) degradation of the pesticide concentration in total soil. Thus, this is one of the cornerstones of the EU regulatory leaching assessment. This assessment is based on the FOCUS groundwater scenarios which use weather series of two years and include crop development and heterogeneous soil profiles. The sensitivity of the FOCUS leaching concentration (evaluated at 1 m depth) to the parameter describing the curvature of the Freundlich isotherm (i.e. the Freundlich exponent N) as derived from simulations with these models shows a sharp decline with decreasing Freundlich exponent with the concentration going down to a submolecular level. This is counterintuitive and difficult to understand. Explanations may be found by studying a simplified version of these sophisticated models, i.e. a assuming a homogenous soil profile with pesticide properties that are constant with depth and assuming a constant water flow rate and a constant volume fraction of water (further called ‘simplified Freundlich-SFO system). Previously it was shown that a pulse of pesticide applied at the soil surface in this simplified system has a finite leaching depth beyond which no pesticide molecule passes. Simulation of a series of experiments of N for a few FOCUS groundwater scenarios were compared to this effect on the percentage leached with this simplified model and qualitatively these effects were found to be similar. Next it was shown that this finite penetration depth after infinite time in the simplified Freundlich-SFO system increases slowly when N increases from 0.5 to about 0.85; however, when N approaches 1, this finite penetration depth goes to infinity. This was expected because this finite penetration depth does only occur in a system with a Freundlich isotherm and not in a system with a linear isotherm. It was checked by inspection of a concentration profile of one of the FOCUS groundwater scenarios that these scenarios also show a finite penetration depth for low N values at the end.
The characteristic time for uptake and loss requires only few input data, is based on validated models and can be calculated with the following equation:

\[ \tau = \frac{K_m}{k_2} \]

where \( K_m \) is the partition coefficient and \( k_2 \) is the second-order decay constant. The characteristic time typically ranges from 10 to 100 days, depending on the chemical and environmental conditions.


8 Partitioning of chlorinated paraffins (CPs) to organic matter is not class specific: implications for bioaccumulation?

9 Trophic magnification of cyclic volatile siloxanes (D4, D5, and D6) in a freshwater lake: A Monte-Carlo analysis

The trophic transfer of cyclic volatile siloxanes (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk. These compounds are bioaccumulated in aquatic organisms, with the bioconcentration factor (BCF) being a key parameter. The bioconcentration factor is defined as the ratio of concentration in an organism to concentration in the surrounding water. In our study, we used a Monte-Carlo simulation to estimate the BCFs for the three cVMS materials observed in Lake Pepin, Minnesota (USA) for food web. The objective of this work was to determine if cVMS materials are biomagnified in this freshwater ecosystem. To determine whether the benthic influence in the Lake Pepin aquatic food web affected the trophic magnification factor (TMF) values for the cVMS compounds, a companion study was conducted to determine the biomagnification and TMF value of a reference material, 2,2',3,3',4,4',5,5'-heptachlorobiphenyl (PCB-180), in Lake Pepin. TMFs for the three cVMS materials and PCB-180 were determined using standard methods and validated models, indicating the importance of considering bioaccumulation in aquatic ecosystems.
methods involving feeding guild, trophic guild classifications, and the stable isotopes of nitrogen (d15N) and carbon (d13C) to estimate trophic position/carbon flow. The aquatic food web consisting of two benthic macroinvertebrate species and 15 fish species was evaluated for trophic magnification of cVMS materials and PCB-180. Lipid-normalized concentrations of D4, D5, and D6 were greatest in the lowest trophic levels and significantly decreased going up the food web, with the lowest concentrations being observed in the highest trophic levels. TMFs measured for the three cVMS materials were all99% of the uncertainty for cVMS TMF values in Lake Pepin was explained by uncertainty at the base of the food web (89%) and at the top of the food web (11%). By comparison, PCB-180 had a TMF of 2.2 in the evaluated food web, indicating biomagnification. TMFs for the cVMS chemicals and PCB-180 were determined using a Monte-Carlo probability analysis technique, and the likelihood that the values exceeded unity was less than 0.5% for all three cVMS compounds and >99.5% for PCB-180. This evaluation indicates that D4, D5, and D6 do not biomagnify in the benthic-dominated Lake Pepin aquatic ecosystem, a food web which does demonstrate biomagnification of the legacy contaminant, PCB-180.

10 Distribution and Bioaccumulation of Polycyclalogenated Carbazoles in Aquatic Systems from the United States and China

D. Chen, Jinan University / Cooperative Wildlife Research Laboratory and Department of Zoology; Y. Wu, Southern Illinois University Carbondale / Cooperative Wildlife Research Laboratory and Department of Zoology; R. Sutton, San Francisco Ecosystem Science Institute; K. Xu, Louisiana State University / Department of Oceanography and Coastal Sciences

The present study reports the discovery of a suite of polycyclalogenated carbazoles (PHCZs) in aquatic sediments collected from four watersheds located in the United States and China, including the Gulf of Mexico (USA), San Francisco Bay (USA), Lake Tai (China), and Lake Dianzhan (China), and their bioaccumulation in the San Francisco Bay ecosystem. A total of 11 halogenated carbazoles, including 3-chloro, 3,6-dichloro, 1,3,6,8-tetrachloro, 2,3,6,7-tetrachloro-, 3-bromo-, 2,7-dibromo-, 3,6-dibromo-, 1,3,6-tri bromo-, 1,3,6,8-tetrabromo-, 1-bromo-3,6-dichloro-, and 1,8-dibromo-3,6-dichlorocarbazole were screened. Halogenated carbazoles were detected in 98.7% of the sediment samples, with concentrations ranging from below method limits of quantification to 51.5 ng/g dry weight. In most of these sediment samples, PHCZ concentrations exceeded those of polybrominated flame retardants (PBDEs). The latter group of chemicals has been demonstrated to be persistent and globally distributed. PHCZs were also detected in various organisms from the San Francisco Bay, including bivalves, sport fish, harbor seal blubber and bird eggs. The median concentrations of PHCZs by species ranged from 33.7 to 164 ng/g lipid weight. Biomagnification was also observed from fish to harbor seal and was mainly driven by chlorinated carbazoles, particularly 36-CCZ. Congener compositions differed among species, suggesting that individual congeners may be subject to different bioaccumulation or metabolism in species occupying various trophic levels in the studies system. Toxic equivalent (TEQ) values of PHCZs were determined on the basis of their relative effect potentials (REP) compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The median TEQ ranged from 4.8 to 19.5 pg TEQ/g lipid weight in biological tissues. Our data demonstrated the broad exposure of PHCZs in the studies systems and potentially in global aquatic systems. These findings raise the need of additional research to better elucidate their sources, environmental behavior, and fate in global environments.

11 Bioconcentration factors of constituents of essential oils in fish determined in an in vivo benchmarked dietary exposure study: A case study for pine oil

C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACE5); M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry; M. Lithner, Stockholm University / Department of Environmental Science and Analytical Chemistry; P. Henriksso, Stockholm University / Stockholm Resilience Centre; E. Groen, Aretö Consulting GmbH / Animal production systems group

Environmental Life Cycle Assessment (LCA) relies on data, models and knowledge from almost all environmental scientific disciplines, including related uncertainties. In addition, LCA involves making methodological choices. Over the past five years, we have published several approaches to deal with data and methodological choice uncertainties. One often heard critique is that these proposals do not address yet for ‘correlations’. We distinguish between two meanings of the term ‘correlations:’ correlated sampling: when applying Monte Carlo sampling for propagating uncertainty data for a comparative LCA study, the sampling can be either dependent (correlated) or independent (uncorrerlated). Independent sampling implies that data are independent. In other words, the data are sampled in different MC procedures resulting in different data sets for this shared process for both product alternatives. Dependent sampling implies that process data for the product alternatives compared are sampled based upon one and the same random drawing of parameter values resulting in identical data sets for this shared process; correlated data points: a transport process input of diesel is, for example, related to an process output of CO2 (emission); if the process consumes more diesel for the same amount of transport, the CO2 emission will also increase. The first interpretation of ‘correlation’ has been addressed in earlier work by Henriksso et al. and recently again by Mendoza et al. The second interpretation of ‘correlation’ (between data points) has recently been addressed by Groen et al. We present an overall framework integrating the methodological choice uncertainties. In addition, LCA studies. In addition, we show the possibilities and limitations of also including data correlations into LCA uncertainty assessments. Practical application of this
framework in the daily practice of LCA practitioners needs further work, including implementation in LCA software programs and particularly data.

14 Drivers of variability and uncertainty in the chemical footprint of personal care products

M. DouËuf, Radboud University Nijmegen; R. Oldenkamp, Radboud University Nijmegen / Department of Environmental Science; H. King, Uleveer; R. University, J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science; A. Ficheux, A. Roudot, Universite de Bretagne Occidentale; R. Van Zelm, Radboud University / Department of Environmental Science

Chemical footprinting of products, quantifying the potential environmental impact of the product’s chemicals, could be used to inform consumers choice. However, the use of chemical footprints (ChFs) for comparative purposes requires a full understanding of the uncertainty and variability sources influencing its quantification. The goal of this work was to determine the ChFs for personal care products and quantify the variability and uncertainty in the different parameters used to derive these individual ChFs. In a first phase, we focused on shampoos. The environmental impact of each ingredient was derived from an environmental load, assuming 100% discharge to the drain, determined by the ingredient’s removal in activated sludge wastewater treatment plants (WWTPs) simulated using SimpleTreat, and a characterisation factor estimated with USEtox. The physico-chemical and ecotoxicological properties applied in both models were all estimated. Their reliability was derived from the prediction accuracy of the estimation models used (EPISuite, ACD Labs, ECOSAR). A Monte Carlo analysis with 1000 iterations was then performed, combining the uncertainty and variability of the different parameters, to determine the spread in ChFs. The ChFs derived by this approach spanned nearly 4 orders of magnitude (95% Confidence Interval (CI)). The wide span of the ChFs’ 95% CI was primarily attributable to fragrances (61%), surfactants (20%), and the scenario analysis used (16%). The significant contribution from fragrances and surfactants can largely be explained by the uncertainty in their environmental impacts described by the characterisation factors derived with USEtox and more precisely the estimated ecotoxicity values. These preliminary results question the use of absolute values when communicating product’s chemical footprints. As long as more reliable ecotoxicological assessments are not available, identifying relative contributions to the overall environmental impacts might be more useful to target specific actions.

15 Combined uncertainty and scenario analysis within Life Cycle Assessment of waste management systems

V. Bisinella, DTU (Technical University of Denmark) / DTU Environment; K. Conradsen, DTU Technical University of Denmark / DTU Compute; T.H. Christensen, DTU Technical University of Denmark / DTU Environment; T. Astrup, Technical University of Denmark / Department of Environmental Engineering

Life Cycle Assessment (LCA) is being increasingly used for decision support in the waste management field. LCAs are subject to uncertainty regarding both the input values for the LCA model (or parametrical uncertainty) and its modelling choices (or epistemic uncertainty). Parametrical uncertainty can be systematically addressed with parametrical uncertainty analysis, while epistemic uncertainty can be addressed with scenario analysis. However, the communicability and usefulness of two analyses (or, the scenario analysis used) can be hindered by the fact that both such analyses are carried out separately, dividing the interpretation of the results in two separate channels and potentially limiting the value of LCA as a decision support tool. This study presents a novel method that aims at combining uncertainty analysis and scenario analysis, illustrated on a case study on three hypothetical waste management options for treatment of residual household waste in the municipality of Copenhagen in 2025. The waste management solutions were provided with uncertainty for the model input values (parametrical uncertainty) and were assessed within four different hypothetical background conditions (scenario analysis). Within each impact category, the results of the parametrical uncertainty analysis were used to identify the most robust waste management option, i.e. the waste management option obtaining the highest average probability measure of providing the best environmental performance across the considered background scenarios. The method allowed obtaining various levels of analyses for the interpretation of the LCIA results: parametrical uncertainty analysis for each of the assessed waste management options, with identification of the parameters mostly contributing to the uncertainty around the results, within each of the assessed scenarios for the background conditions. This allows for discernibility analyses across background conditions, allowing obtaining useful insights on the changes in sensitive parameters induced by the change in background conditions. The discernibility analysis results allowed obtaining a clear quantification of the probability measure of each waste management option to provide a better environmental performance than another, for each of the assessed impact categories and investigated background conditions, and in a manner simply conveyable to the users and final receivers of the LCA.

Which impact categories are relevant for LCA results interpretation?

A. Enouf, Institut National de la Recherche Agronomique, Narbonne-France / UN Laboratoire de Biotechnologie de l’Environnement; E. Latrille, J. Steyer, INRA LBE; A. Hélias, Montpellier SupAgro / LBE ELSA

LCA is intrinsically a multicriteria approach comparing (almost) all the potential environmental impacts of human activities. However, multicriteria decisions pose challenges as a wide range of environmental impacts results may lead to unclear conclusions. Based on their relevance, a choice among the impact categories to be considered may be necessary. It can be carried out by examining how the information given in the Life Cycle Inventories (LCIs) is used by the impact categories. The Representativeness Index (RI) proposed by Enouf et al. was initially used to compare the adequacy of Life Cycle Impact Assessment (LCIA) methods regarding LCIs. Here, the RI is used to explore the impact categories belonging to a given LCIA method. Thus, the present study focuses on how the interpretation of the LCA results can be undertaken given the choice of relevant impact categories. With a geometrical standpoint, LCIs of the ecoinvent database and impact categories of the ILCD method are standardized and localized within the same R-vector space. This vector space is generated by all the dimensions (i.e. elementary flows) from which the LCIs of the database are developed. The RI is a proximity measurement between the standardization of LCI vectors and standardized impact category vectors, corresponding to the cosine of the angle between two vectors. This measurement does not assess the relevance of the environmental model behind impact categories, but rather translates the main elementary flows from an LCI based on how they are represented by the impact categories of an LCIA method. Two inventories referred to the Life Cycle Inventory (LCI) regionalization deals with in this study as an illustrative example (areas analysed: NPPC, North-eastern North America, U.S. only, and Germany). Results show that comparing the NPPC and the German electricity mixes is more relevant based on the ionising radiation impact categories. The freshwater eutrophication, the climate change and the ozone depletion are the three other impact categories that focus on the main environmental issues that best represent those two LCIs. The RI used to compare the LCIs and the RCIA method provides additional information for characterizing the impact categories towards LCI representativeness within the global context of a given database. While performing a LCA study, practitioners could benefit of the developed methodology to select impact categories to focus the results interpretation on relevant environmental issues.

17 Reduce the uncertainty of LCA results by prioritizing the regionalization effort: a sectorial meta-analysis

L. Patouillier, CIRAIG - École Polytechnique de Montréal; P. Collet, IFP Energies nouvelles; P. Lesage, CIRAIG; P. Tirao, CIRAIG; C. Bulle, CIRAIG - ESG - UQAM / Strategy & corporate social responsibility; M. Margni, École Polytechnique de Montréal / Mathematical and Industrial engineering

Uncertainty in Life Cycle Assessment (LCA) can limit the results interpretation. Regionalization is one of the ways to reduce the uncertainty due to spatial variability. Life Cycle Inventory (LCI) regionalization deals with investigating the geographic representativeness modelled in LCI. Life Cycle Impact Assessment (LCIA) regionalization deals with regionalized impact characterization that accounts for the spatial variability of the receiving environment. Regionalized characterization factors (CF) apply to spatialized elementary flows (EF), called LCI spatialization. However, integrating regionalization requires additional effort on data collection and treatment for LCA practitioners and database developers. Thus, prioritizing the regionalization effort on the most sensitive data (input data with uncertainty having the highest influence on the resulting uncertainty) would ensure an optimal use of resources to reduce LCA results uncertainty. This research work proposes a procedure to prioritize regionalization efforts based on global sensitivity analysis (GSA) to reduce the spatial uncertainty of LCA results. We applied this procedure to all the activities of two economic sectors (biofuel production and passenger land transport) defined in the ecoinvent database v3. The regionalized impact methodology IMPACT World+ is used to assess environmental impacts. Statistical tests are then used to derive sectorial recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized first. These recommendations can be used by LCA practitioners and LCI database developers to define their strategy for regional data collection to lower the LCA results uncertainty. Results show that contrasting IC ranking depending on the economic sector. For the biofuel production sector, land transformation encompasses almost all the uncertainty, whereas it is distributed among several impacts (global warming and marine acidification) on the land passenger transport sector. For LCA phases ranking, it concludes that inventory should be spatialized in priority for regionalized impact categories. This methodology allows providing different recommendations specific a sector to refine data collection in order to reduce uncertainty and enhance results interpretation. To our knowledge, this is the first time that an uncertainty analysis discriminating IC and LCA phase ranking is performed.

18 Poster spotlight: M0387, M0388, M0389
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (I)

19 Unravelling longitudinal pollution patterns in freshwaters by non-target screening and cluster analysis
L. Beckers, Helmholtz-Zentrum für Umweltforschung GmbH – UFZ / Effect-Directed Analysis; W. Brack, E. Müller, T. Schulze, M. Krauss, Helmholtz centre for environmental research – UFZ / Effect-Directed Analysis
P. Lara, Eawag / Environmental Chemistry
Pollution of aquatic ecosystems with emerging organic contaminants (EOCs) has been intensively studied over the past decades. The vast number of EOCs and their occurrence in complex and variable mixtures is a major challenge for monitoring, risk assessment and management and is beyond the scope of target screening. Thus, novel approaches are needed to characterize these mixtures and identify unknown EOCs including transformation products and natural background. In this study, we propose a novel workflow for unravelling pollution patterns along a river course, identifying longitudinal dynamics of pollutant groups, entry pathways and the fate of EOCs along the river course using non-target screening by LC-HRMS and cluster analysis. Sixteen grab samples were taken along the 42 km-long course of the Holtemme River (Saxony-Anhalt, Germany), whereas the first sampling in the national park marked a reference point for pristine conditions. Chemical screening was performed on an UltiMate 3000 LC system (Thermo Scientific) coupled to a hybrid quadrupole – Orbitrap MS (QExactive™ Plus, Thermo Scientific) with a heated electrospray ionization source. MS/MS analysis was performed in a full scan experiment (100-1000 m/z) at a nominal resolving power of 140,000 at m/z 200. Peak extraction including peak picking, gap filling, componentization and target annotation was implemented in R. Cluster analysis was performed using the R package ‘kml’. Four clusters were suggested for the data set representing A: EOCs from treated wastewater input of the two wastewater treatment plants (WWTP), B: EOCs specific for first WWTP due to specific local emissions, C: EOCs from diffuse (i.e., agricultural and urban surface run-off) and small point-source input (e.g., rain sewers and creeks) and D: low continuous background signals. The identified patterns gave insights into the spatial dynamics of complex chemical mixtures along a river course, highlighting differences in point-sources and areas governed by diffuse input and identifying points of complex mixtures of mixtures (e.g., first WWTP). Deeper investigation including structure elucidation will resolve the origin of non-target signals in these clusters. The proposed workflow proved to be a fast method for unravelling pollution patterns in non-target HRMS data and may also applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

20 Tracing sewage-derived contaminants from mainland towards the ocean by high resolution mass spectrometry
P. Gorniak, P. Lara, P. Bottenberg, University of Cadiz / Physical Chemistry; A. Chíaia-Hernández, Eawag / Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Biel, R. Baena-Nogueras, University of Cadiz / Department of Physical Chemistry; J. Hollender, Eawag / Environmental Chemistry
The ocean is the ultimate sink of most of the organic synthetic compounds produced and consumed by humans. Among the different pollution sources affecting this environment, discharge of treated and untreated sewage from mainland is of high relevance due to its continuous input, high volume and poor efficiency of conventional wastewater treatment plants (WWTP) to remove many potentially harmful substances. Even after dilution, some of these contaminants may still be detected at low concentrations (ppt-pb level), especially in coastal waters, and their effects over marine biota are still widely unknown. This work focused on identifying a wide range of polar and semipolar chemicals that can be detected in both WWTP influents and effluents, as well as in the receiving waters (rivers and estuaries) and even in the open ocean. In order to do this, we carried out several monitoring campaigns in the Gulf of Cadiz (Atlantic Ocean, SW Spain), sampling water from one of the biggest local WWTPs in the area (Jerez de la Frontera, 250 000 inhabitants), adjacent surface river and coastal waters, and oceanic waters at different depths (down to 400 m) taken up to 50 km away from the coastline. Solid phase extraction followed by liquid-chromatography high resolution mass spectrometry were used in combination with statistical tools (e.g., principal component and cluster analyses), specific vendor and open-access software, and orthogonal data sets to tentatively identify more than 350 compounds, and features persistent enough to be also detected in oceanic waters. These compounds included different classes of surfactants (e.g., linear alkylbenzene sulfonates) and their byproducts (e.g., DATS) and metabolites (e.g., NPEC), polymers (PEG, PPG and many ethoxylated derivatives), pharmaceuticals (e.g., valsartan, diclofenac, carboxacizapene, etc.), personal care products (UV stabilizers) and food additives (e.g., sucralose), some of them (e.g., sulfon) identified in the environment for the first time. The list of compounds reflected here not only shows many of the substances that can potentially escape from wastewater treatment but also constitutes a first step towards a more detailed characterization of the chemical exposure in the marine environment.

21 Pharmaceuticals, personal care products (PPCPs), and artificial sweeteners (ASWs) in river and groundwater from the Ganges River Basin, India
B.M. Sharma, Researcher; C. Billen, Chemistry; E. van Damme, Department of Chemistry, Faculty of Science, University of Antwerp; B. Becheler, Department of Chemistry, Faculty of Science Masaryk University / Faculty of Science; J. Bečanová, Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island 02882 / Chemical Oceanography; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; L. Nizzetto, NIVA
Pharmaceuticals and personal care products (PPCPs) and artificial sweeteners (ASWs) are environmental contaminants of emerging concern. In this study, we investigated the occurrence and distribution of 15 pharmaceuticals and personal care products (PPCPs) and five artificial sweeteners (ASWs) in surface and groundwater of the Ganges River Basin in India. The Ganges River Basin is the largest river basin in India and home of about 7% of the total global population. PPCPs and ASWs were ubiquitously present in the river and groundwater. Most frequently detected compounds were caffeine, DEET, ketoprofen, cyclamate, and sacralose. Except caffeine and DEET, concentrations of other PPCPs and ASWs in river water were found to be higher in densely populated areas. Concentrations of PPCPs and ASWs in the groundwater were lower but on same order as detected in the river water. Similar to river water, elevated concentrations of PPCPs and ASWs in groundwater were detected in middle and lower reaches along the Ganges River. PPCPs and ASWs concentrations were lower than those in developed countries, still, their instantaneous loads in the Ganges River were comparable to those in rivers from developed countries. The presence of PPCPs and ASWs in the surface and groundwater can be interpreted as a consequence of inefficient wastewater management in the basin, which pose a concern for human exposure.

22 Data-dependent fragment ion search for detection of sartans and related compounds in wastewater and surface water
B. Zoonje, IDAEA-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environmental Assessment and Water Research IDEA-CSIC / Department of Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry
The presence of polar contaminants like angiotensin II receptor antagonist pharmaceuticals (sartans) in the aquatic system is directly linked to human impact. Like other xenobiotics, they can be metabolised in the body with enzymes such as cytochrome P450 (CYP), UDP-glucuronosyltransferase (UGT), and glutathione transferases (GST) which are present in the human liver at high abundance. Due to biological and/or abiotic processes that the contaminants undergo from the discharge site to the ground or surface water where they are detected, they can be transformed to transformation products (TPs). These TPs are usually detected and identified first at lab-scale in order to evaluate the degradability of a compound. This is typically followed by a targeted method development and it is not until the compounds have been identified in those systems or other systems that they are actually searched for in real aquatic samples to report their presence. Here, we propose an alternative approach, based on data-dependent fragment ion search, where real-world samples are initially screened for plausible TPs, metabolites or related compounds. The starting point here was a suspect screening of a list of all marketed sartans in wastewater effluent and surface water samples, which were extracted with a generic solid-phase extraction method using four cartridges with different chemistries. Out of the compounds detected, five of them had an identical core structure, and it was postulated that this sub-structure would fragment identically in all compounds. Following a series of experiments with different MS parameters modified, a list of hit compounds was obtained using fragment ion search. After all of the compounds investigated, available human metabolites and internal standards were purchased, a set of biodigestion experiments using activated sludge was performed in order to “source” the detected m/z and compare the possible TPs fragmentation to the one obtained in the bio-reactors. In parallel, a literature search for reported human metabolites was used to complement the identification of compounds detected in cases where no such compound was found to bio-accumulate. This approach is presented using antibodies as selectors to pre-screen fractions of an
HPLC run for “binding” in order to detect hitherto known but structurally related compounds. Carbamazepine (CBZ), an anti-convulsant and anti-depressant, sulfamethoxazole (SMX), an antimicrobial for humans, and estrone (E1), a hormone and estradiol metabolite have been studied by this LC-ELISA approach. Immunoassays had been developed for all compounds but overestimations of wastewater concentrations were frequent, with CBZ even at a constant level (+30 %) that did not result from the considerate cross-reactivity to CBZ (≥10,1-epoxide (ca. 70 %) or 2-hydroxy-CBZ (14 %). Fractions from HPLC runs of pre-concentrated wastewater samples were collected into a 96-well glass plate in small aliquots, with fractions adapted to the desired resolution along the run. One plate is sufficient to collect a 30 – 40 min. run. The fractions were evaporated to dryness under a gentle stream of nitrogen. Before ELISA analysis, all fractions were dissolved in a constant solution of µl of 0.1% TOP-ESI-MS and applied on a specifically “positive” fraction revealed an exact mass of m/z = 389.168 and a chloride pattern. The compound is cetirizine, an antihistaminic. It appeared in our samples from spring on and was responsible for 20 % of the overestimation we found initially with the CBZ antibody. The LC-ELISA for SMX displayed a series of unidentified peaks in the ELISAgram. Careful analysis of the fractions led to the identification of N4-acetylsulfamethoxazole, an SMX metabolite which is present in the samples. With estrone, interferences by polar matrix compounds eluting early could be identified.

24. Designing a risk based monitoring program for groundwater sources for drinking water production – based on target and suspect screening combined with clustering techniques

R. Sjerps, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Brunner, B. Bajema, Vitens; P. Bauerlein, KWR / Analytical and Environmental Chemistry; M. de Jonge, Vitens; Y. Fujita, M. Schriks, KWR Watercycle Research Institute; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health

Drinking water utilities heavily invest in monitoring occurrence of chemicals in drinking water sources and produced drinking water. Worldwide, drinking water regulation prescribes drinking water limits for a limited number of chemicals, the EU Drinking Water Directive (EU DWD) for example lists drinking water limits for 26 organic and anorganic chemical parameters. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and bioanalytical methods. The EU DWD stipulates that drinking water monitoring is performed in a more flexible way, provided protection of public health is ensured. Compared to surface water, groundwater is less intensively studied and monitored. However, groundwater can be highly influenced, by anthropogenic activities related to the land-use above the groundwater, by infiltrating surface water, by historical contamination as well as by activities in the sub-soil. The susceptibility of the groundwater aquifers to these pressures depends on soil type and groundwater hydrology. Chemical properties such as persistence and mobility and their retardation during groundwater flow are reflected in the spatio-temporal patterns of the chemicals. Treatment technology applied, such as filtration and sorption techniques, determines removal efficiencies during drinking water production for specific compounds. Water utility Vitens services drinking water in a large area in the Netherlands, mostly using groundwater as a source. Their set of chemical parameters in the monitoring program tripled in the last decade. The water utility aims to prioritize their measured chemicals and develop a tailored risk-based monitoring program. We propose a method to design a risk-based monitoring program for all 15 supply zones involved, mostly consisting of groundwater. We use both target and non-target and suspect monitoring data and well characteristics. We use clustering techniques combined with prioritization techniques including substance properties and in vivo as well as in vitro toxicity information. We analyse full scale removal efficiencies by the treatment technologies applied. Finally we propose a risk based monitoring program.

Wildlife ecotoxicology: laboratory dosing studies to field population assessments (I)

An interspecies correlation model to predict acute dermal toxicity of plant protection products to terrestrial life stages of amphibians

L. Welge, P. Janz, BASF SE, Crop Protection - Ecotoxicology; P. Sowig, Bayer CropScience / Ecotoxicology

In this presentation, a model to predict acute dermal toxicity of plant protection products to terrestrial amphibian life stages from (regulatory) fish data will be presented. By combining existing concepts, including interspecies correlation estimation (ICE), allometric relations, lethal body burden (LBB) and biotransformation modelling, an equation was derived that predicts the amphibian median lethal dermal dose (LD₅₀) from standard acute toxicity values (96-h LC₅₀) for fish and biotransformation factors (BCF) in fish. Where possible, fish BCF values were correlated to amphibian BCF and to parent compound. Then, BCF values were adjusted to an exposure duration of 96 h, in case steady state took longer to be achieved. The derived correlation equation is based on 32 LD₅₀ values from acute dermal toxicity experiments with 15 different species of anuran amphibians, comprising 15 different plant protection products. The developed ICE model can be used in a screening approach to estimate the acute risk to amphibian terrestrial life stages from dermal exposures to plant protection products with organic active substances. Applying this method has the potential to reduce unnecessary testing of vertebrates.

26. Overview of the EFSA Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles

S. Peiper, German Federal Environment Agency (UBA) / Plant Protection Products; P. I. Adriaanse, Alterra Wageningen University and Research Centre; A. Aitchison, Agroscope / Ecotoxicology; C. Berg, Upsalla university, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; P. Berny, VETAGRO-SUP / Toxicology; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece; M. Ortiz Santalastre, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; C. Topping, University of Aarhus; S.M. Weir, Queens University of Charlotte / Biology; F. Streliss, EFSA / Pesticides Unit; R. Smith, School of Applied Sciences, University of Huddersfield

Concerns have been raised that the current risk assessment schemes may not sufficiently cover the risk for amphibians and reptiles exposed to intended uses of plant protection products (PPP). To address these concerns, the Food European Food Safety Authority (EFSA) has published a Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles. EFSA Journal 2017; 329 pp. doi:10.2903/j.efsa.20YY. [2] EC. 2009. Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market. OJ L 399/1.
carcinogenic PAHs in blood and DNA fragmentation as well as between Cd in carapace and GGT in plasma. We measured a very sharp band with a molecular weight of 59 kDa in skin sample that can be attributed to CYPA1, never investigated earlier in this species. We also evidenced as the youngest animals showed significantly higher DNA fragmentations, BChE inhibition and increase of GGT, these alterations can be potentially related to their coastal habits. Older specimens showed the highest levels of erythrocyte nuclear abnormalities which may indicate a long-term toxicological stress. This study contributed to expand the knowledge about the ecotoxicology of C. caretta in the Mediterranean, the non-invasive protocol could also be applied to other marine ecosystems and other sea turtle species, and implemented with new endpoints in the near future.

28 Sucking clams or hunting seals - consequences to walrus health
H. Routti, The Norwegian Polar Institute; S. Bourgeois, University of Tromsø / Department of Arctic Marine Biology; B. Diet, UIT The Arctic University of Norway; N. Duale, Norwegian Institute of Public Health; A.T. Fisk, University of Windsor / Great Lakes Institute for Environmental Research; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; E. Hansen, M. Harju, NILU / Norwegian Institute for Air Research; K.M. Kovacs, C. Lydersen, Norwegian Polar Institute; I. Nymo, Norwegian Veterinary Institute; G. Pantì, University of Siena / Department of Physical Sciences, Earth and Environment; S. Scottor, M. Tryland, UIT The Arctic University of Norway; G.D. Villanger, Norwegian Institute of Public Health
The walrus (Odobenus rosmarus) is an ice-associated marine mammal with distinct feeding habits. Concentrations of the main chlorinated pollutants, namely polychlorinated biphenyls (PCBs) and chlordanes, in walruses that likely feed on seals are very high - similar to levels observed in polar bears, whereas pollutants concentrations in walruses feeding on benthos are lower. Although multiple studies have associated contaminant exposure to adverse health effects in polar bears and other marine mammals without contaminant exposure, there are no studies to date investigating effects of pollutants in walruses. The goal of our study was to investigate contaminant and pathogen exposure and endocrine disruption in walruses feeding at different trophic levels. Samples from adult male walruses (n=39) were collected from at Svalbard, Norway. Stable isotope values determined in seven body compartments indicated that all of the walruses in this study fed at a low trophic level. However, concentrations of blubber lipophilic compounds showed very high individual variation. Concentrations of chlorinated compounds have decreased since they were last studied in walruses sampled, in the same area as the current study, during 2002-2004. Plasma PFAS concentrations varied less between individuals. δ15N values in red blood cells and in liver were positively correlated with δ13C values in blubber, but not to PFASs. Antibodies against Brucella spp. and Toxoplasma gondii were detected in 26 % and 15 % of the walrus plasma samples, respectively. Presence of Brucella spp. and Toxoplasma gondii were not related to contaminant exposure or stable isotope values. Among the 5 thyroid hormone concentrations analyzed in plasma, concentrations of TT4 were negatively related to concentration of 2,4-D. We observed transcript levels of 21 target genes in blood cells and 7 target genes in blubber related to endocrine and immune functions by real-time quantitative PCR. The preliminary results indicate few relationships between transcript levels of genes involved in endocrine functions and pollutant exposure.

29 Triclosan-induced embryotoxicity in the yellow-legged gull
C.D. Possenti, Università degli Studi di Milano; G. Poma, S. Defosse, University of Antwerp Toxicological Center; N. Saino, University of Milano; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; M. Parolini, University of Milan / Department of Environmental Science and Policy.
Triclosan (TCS) is a chemical compound extensively used as synthetic and antimicrobial agent in a wide range of personal care products. Because of its hydrophobic nature and its discharge in the sewer system, TCS accumulates in settled sewage sludge and surface water, contaminating aquatic and terrestrial ecosystems. However, our understanding on the toxicity of TCS towards wildlife species is very scarce. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the food web and relative long life-span. Their eggs are a useful tool to monitor the levels of environmental pollutants and their potential adverse effects because these chemicals can be maternally-transferred to the offspring. However, such investigation on TCS is lacking. The aim of this study was to explore embryotoxicity of TCS in the yellow-legged gull (Larus michahellis). In a within-clutch experimental design, 150 mg/g weight of TCS were injected into the egg yolk and the effects on embryo morphology, oxidative stress and genetic damage in embryo liver were investigated. Specifically, we assessed effects on embryo body mass, tarsus length and head size, as well as liver and brain mass. The amounts of oxidant species (i.e. ROS), enzymatic activities (SOD, CAT, GST) and the levels of lipid peroxidation (LPO) were measured as biomarkers of oxidative stress, while levels of DNA fragmentation were measured as genetic damage endpoint. To check for the reliability of the injection method, we quantified TCS concentration in the yolk of unincubated eggs, while to assess its transfer to the embryo, we measured TCS in residual yolk and in the liver and brain. TCS concentrations in yolk from unincubated eggs were similar to the nominal ones (159.9±35.3 µg/g wet weight), while lower concentrations were found in residual yolk soon before hatching (2.9±1.1 µg/g wet weight). TCS was also detected in the liver (2.3±1.1 µg/g wet weight) and limitedly in the brain (0.2±0.1 µg/g wet weight). TCS treatment did not show any significant effect on the embryo morphology traits. However, TCS significantly increased ROS levels and promoted GST activity, leading to a marginally non-significant increase of both oxidative and genetic damage. Thus, these findings demonstrated, for the first time in a wild bird species, that TCS may affect offspring phenotype and may represent a potential threat for coastal ecosystems.

30 Egg overspray with herbicides and fungicides reduces chick survival in red-legged partridges
M. Ortiz Santalestra, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; V. Alcaide, IRIAF / Centro de Investigación Agroambiental El Chaparrillo; R. Mateo, IREC-CSIC - UCLM / Grupo de Toxicología de Fauna Silvestre; F. Mougeo, IREC
Toxicity characterization in pesticide risk assessment for birds is derived from oral exposure of adults. However, for ground-nesting species, a temporal and spatial overlap of egg laying and incubation with pesticide applications may result in direct exposure of the eggs. Using formulations commonly applied to cereal crops in spring, we conducted two experiments in 2016. Likewise, potential of 2,4-D and tepobonazole on embryonic development and post-hatching survival of a common farmland bird, the red-legged partridge (Alectoris rufa). The first experiment simulated egg overspray with pesticides and the second one the incubation of eggs upon a soil that had been previously sprayed. For both experiments we used an application rate, corresponding to a 30% of the labelled application rate of each product (i.e. assuming a 70% interception by crop), and a control consisting of a water application in stead of pesticide formulations. Eggs were incubated at 37°C and 45% humidity until hatching (23-26 days). Sixteen eggs per treatment were removed from the experiment at different incubation times to analyse pesticide uptake (ongoing analyses, results will be presented at the meeting), and a minimum of 20 chicks per treatment was monitored for embryonic development and post-hatching survival. Chicks were weighted and measured (tarsus length), and body condition calculated, at hatching and at days 8, 16, 24 and 32 post-hatching. Egg overspray with pesticides significantly increased chick mortality (Wald’s X² = 29.909, 14 d.f., p = 0.008). Although pesticides did not affect surviviorship at hatching time, in ovo exposure to both 2,4-D and tepobonazole caused increased mortality of chicks afterwards, resulting in a reduction of productivity 32 days after hatching of 30.6 and 25.9%, respectively. Incubation of eggs in pesticide applied soils did not significantly affect chick survival (Wald’s X² = 15.603, 14 d.f., p = 0.338), and nesting growth was not affected in either experiment by embryonic exposure to pesticides. These results suggest that reduction of embryonic and chick survival because of egg overspray with pesticides can be a potential way by which these products can affect reproductivity. Consequently, a temporal and spatial overlap of egg laying period and pesticide applications may result in a reduction of productivity in avian species on avian reproductive output. Financed by the Spanish Ministry of Economy and Competitiveness (Project ref. CGL2016-75278-R)

Biocides and Veterinary Medicines: latest developments in regulatory risk assessment, research and monitoring

31 Regulatory improvement in the assessment of environmental risks from veterinary medicines; a European Perspective
I. Weeks, Joint Nature Conservation Committee
This presentation will focus on the developments in the environmental risk assessment of veterinary medicines from a European regulatory perspective. There is a need to continuously develop and react to changing requirements to perform more sophisticated, quantitative or robust environmental risk assessments for veterinary medicine products. The centralised approval of new veterinary medicines within the EU, is the responsibility of the European Medicines Agency (EMA); however, developed best practices are shared by all member states. The EMA also aids in coordinating other European procedures with several member states involved. EMA frequently authorises and takes advice from specialist working parties aligned to the specific provision or modification of regulatory guidelines or procedures within the committee for veterinary medicine products (CVM). There are such group focuses on the improvement of the guidance to industry and other stakeholders on environmental risk assessment alongside the provision of reflection documents that aid understanding or address specific areas for clarification in regulatory procedures. The overview will highlight some of these recent developments, in improved regulatory advice for current or future procedures. It will summarily cover issues around assessing and limiting veterinary medicines in groundwater, the use of higher tier testing of dung fauna, the use of higher tier plant testing, improvements in PBT assessments, future plans around developing improved guidance for the assessment of risks from aquaculture.
medicines and the role of veterinary medicines in driving AMR in the environment and its potential consequences and mitigation. The session will feature successes, current issues and developments in improving the guidance on the assessment of veterinary medicines in the environment; and will reflect on the future challenges and difficulties faced by the regulators and industry alike. This paper will acknowledge the significant continuing contribution made by the Environmental Risk Assessment Working Party (ERA-WP) of the CVMP.

32 Risk of veterinary medicines to plants: Reflections for an updated approach. R. Carapeto Garcia, Spanish Medicines Agency / Veterinary medicines; A. Haro Castuera, Spanish Medicines Agency / Veterinary Medicine Department; G. Cortés Ruiz, C. Rubia Montejano, Spanish Medicines Agency / Department of Veterinary Medicines

In an Environmental Risk Assessment (ERA) the General Protections Goals need to be translated into Operational Protection Goals in order to achieve efficient and robust ERAs. Not doing so hinders the process of Risk Management in those cases where a risk is identified. In the current regulatory framework of ERA of Veterinary Medicines, the protection of ecosystems ("Protection of ecosystems") is not translated into Operational Protection Goals. Hence, when risks are found it is complicated to manage or mitigate such risks. In the taxonomic level of "terrestrial plants" some VMHPs have shown different levels of risks. From the Risk Assessor perspective it is difficult to deal with these risks, partly due to the lack of guidance on Operational Protection Goals. Here we analyze a proposal of a new watercourse approach, and used for exposure assessments at field scale. The risk assessment of terrestrial plants: “Protection of Human Interest” and “Protection of Environmental Interests”.

33 Innovative environmental assessment of a veterinary medicinal product: watershed-level impacts of trenbolone acetate and 17β-estradiol

J.P. Staveley, Q. Ma, J. M. Exponent; C. Celly, Intervet Inc. dba Merck Animal Health; G. Scheef, MSD Animal Health Innovation GmbH / Preclinical Development

Environmental assessments of pharmaceuticals are required by regulatory authorities as part of the drug approval process. Revalor-XR is an extended-release implant for use in cattle fed in confinement (steers and heifers) that contains trenbolone acetate and 17β-estradiol (17β-E2) as active pharmaceutical ingredients (APhIs). Both APhIs are metabolized in situ resulting in the excretion of 17β-trenbolone (17β-TB), 17α-trenbolone (17α-TB), testosterone (TBO), 17β-E2, 17α-estradiol (17α-E2), and estrone (E1). The similarity in chemical structures and metabolism of the environmental fate properties among 17β-TB, 17α-TB, TBO, and that among 17β-E2, 17α-E2, and E1 promote the use of surrogate compounds to represent the trenbolone compounds and the estradiol compounds in the environmental assessment. Data on the individual compounds were collected from various laboratory studies and literature sources, aggregated to generate representative values for the surrogate compounds to characterize their environmental fate, and used for exposure assessments at field scale and watershed-scales. Nine exposure pathways were evaluated at the feedlot and field scale, allowing for elimination of insignificant pathways for the watershed-scale modeling, which considered the major exposure pathways and was conducted for two representative watersheds, one in Texas and one in Iowa, using the U.S. EPA's BASINS/HSPP model. The outputs of the modeling efforts resulted in Predicted Environmental Concentrations (PECs) for the surrogate compounds for individual as well as aggregated exposure pathways. The effects assessment was focused on potential reproductive impacts to fish from chronic exposure, which is the most sensitive ecological endpoint for these compounds, and generated Predicted No-Effect Concentrations (PNECs) for 17β-TB, 17α-TB, 17α-E2, and 17β-E2. Risk characterization involved comparison of the PECs for the surrogate compounds to the PNECs of the individual compounds. The assessment at the watershed scale demonstrated that it is highly unlikely that the compounds associated with Revalor-XR would have any significant environmental impacts when used according to the Revalor-XR label. The environmental assessment supported a Finding of No Significant Impact by the U.S. Food and Drug Administration from the use of Revalor-XR in beef steers and heifers in the US.

34 How can mesocosm studies increase realism in risk assessment of biocides and veterinary medicines? L. Dören, ERM / Product Stewardship; U. Hommen, Fraunhofer IME; P. Eb, MSD Animal Health Innovation GmbH / Preclinical Development

Mesocosm studies can be used to assess the environmental impact of potential stressors based on model-ecosystems under realistic environmental conditions. They are an important link from laboratory to field. Mesocosms provide the assessment of a broad range of different species of different ecological groups forming food webs with complex interactions. Therefore mesocosm studies can support a better understanding of the environmental impact of stressors on population level as well as on ecosystem level (e.g. direct and indirect effects on community structure and ecosystem functions as primary production). In addition, mesocosm studies provide data on the fate of test substances under realistic outdoor conditions, which can be used to test the prediction based on laboratory studies. While for the risk assessment of Plant Protection Products (PPP) mesocosm studies are an established higher tier approach and are considered as the surrogate reference tier, the use of mesocosm studies for risk assessment of biocides, veterinary medicines and chemicals under REACH is rare, although mesocosms from the Guidance on the Generation of data and chemical safety assessment - Chapter R.10: Characterisation of dose [concentration]-response for environment and in the Guidance on the Biocidal Products Regulation - Volume IV Environment - Assessment and Evaluation both provided by ECHA. One reason for this might be, that mesocosm studies have the reputation to be very complex and difficult to evaluate by regulatory authorities, presenting a challenge to take some fears of contact with mesocosms. It will explain the most important aspects to validate the quality of a mesocosm study and the relevance of the results. Further, it will give some insights to the use of (aquatic) mesocosm studies in the context of PPP risk assessment and will provide important aspects for planning a mesocosm study for biocides, veterinary medicines and chemicals in the context of REACH.

35 Emission estimation of insecticides in mink farms

R.G. Ovesen, Danish Environmental Protection Age; H. Bækgaard, Kopenhagen Fur

Biocides are regulated in EU by the BPR [1]. To evaluate if an active substance (a.i.) or product may be authorised, an assessment of the environmental exposure is required. For insecticides used in stables an Emission Scenario Document (ESD) [2] is used covering application methods and a range of animal categories. The ESD does not cover biocides used in mink farms. A scenario has therefore been developed, where emission of a.i. from mink farms is calculated based on either amount applied or measured concentration in straw. Default values have been established from regulation and general practice in mink production in the Nordic countries, where Denmark has the highest production of mink in Europe [3]. Each breeding animal is kept individually in one cage to be treated at the start of the season. Mother and cubs stay together in one cage and are separated into pairs after lactation, where all cages are retreated. Each mother will bear 5.55 cubs/year according to Danish regulation [4]. The number of "breeding females" (BF) is 1 mother+5.55 cubs. The number of nest boxes that is treated/BF may be calculated as follows: 1 animal/nest box before separation and 6.65/2 animals (3.275/nest boxes after separation. In Europe it is prohibited to discharge waste from stables to public sewer. Emission is therefore only expected to be to agricultural land. Emission of manure/straw may be from up to 50 BF per hectare (ha) per year based on regulation in the Nordic countries. Emission according to application pattern: Y = Q*m*a*m, F = (N_{ap}*_b_t_e_r_{ap}*_c_r*)/x*B = 10^15 x 65 kg/ha per (Equ. 2). Where amount of straw used per BF is 10-15 kg/year according to Kopenhagen Fur. The emission based on Nordic countries regulations and information from Kopenhagen Fur on amount of straw used per BF is 50 BF per ha x 15 kg straw per BF=750 kg straw per BF. Predicted Environmental Concentration in soil may be calculated according to Volume IV Part B [5].

36 Biocidal active substances in municipal wastewater - what product groups are the sources? S. Wieck, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; O. Olsson, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; K. Kümmner, Leuphana University of Lüneburg / Institute of Sustainable and Environmental Chemistry

The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater.
that washing and cleaning agents are important sources for preservatives such as BIT and OFF, while triclosan was apparently mainly emitted through personal care products. The mosquito repelling substances DEET and icaridine were found throughout the whole year, with highest emissions in summer and autumn. C12-benzalkonium chloride concentrations were associated with the inventoried disinfectants. Material preservatives such as terbutryn, diuron, tebuconazole or carbanilide were also detected. As these were not listed on the inventoried products, emission via treated materials such as paint, render, seals or textiles seems likely. We were able to show that biocidal active substances are emitted from the inside of households in considerable concentrations. Those emissions are not only due to biocidal products but also washing and cleaning agents, personal care products and preserved materials. For this reason, measures should not only tackle biocidal products when it comes to the reduction of biocidal active substances in wastewater.

The environment as a reactor determining fate and toxicity of nanomaterials (I)

37 Comparative multi-generation study of long-term effects of pristine and wastewater-borne silver and titanium dioxide nanoparticles on reproduction in Daphnia magna
S. Hartmann, University of Siegen, Institute of Biology / Department of Chemistry and Biology; R. Louch, University of Manchester; R. Zeumer, Fraunhofer IME / Institute for Molecular Biology and Applied Ecology / Bioaccumulation and Animal Metabolism; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; K. Witte, University of Siegen / Department of Chemistry and Biology

Manufactured nanomaterials (MNMs) and especially Ag- and TiO2-NPs are present in daily used products such as cosmetics, clothing and in medical supplies. After passing wastewater treatment plants these MNMs reach the aquatic environment and can accumulate in the aquatic ecosystem and cause toxicity to aquatic organisms. To assess the risk potential of these NPs to aquatic invertebrates under more realistic circumstances, we investigated and compared possible effects of pristine Ag-NPs and TiO2 NPs with those after passing a model wastewater treatment plant on the reproductive success (number of offspring), mortality and body size of adult daphnia as endpoints up to six generations. We exposed daphnia to: (i) pristine Ag-NPs (NM300K) and TiO2-NPs (NM105) or (ii) wastewater borne Ag- and TiO2-Nanoparticles from effluent from the model WWTP. The first generation of daphnia was exposed to four concentrations of Ag-NPs (nominal: 1.25 µg/L, 2.5 µg/L, 5.0 µg/L and 10.0 µg/L), to solvent control (NM300K DIS), or to three concentrations of TiO2-NPs (nominal: 25 µg/L, 50 µg/L, 100 µg/L) in line with the OECD guideline No. 211. Each generation was exposed for 21 days and started with the third brood from the previous one. In all six generations the exposure with pristine Ag-NPs (NM300K) for 21 days caused a significant reduction in the mean number of offspring in daphnia compared to the control. However, wastewater-borne Ag-NPs had no effects on reproduction in any generation, although the mean number of offspring per body length of daphnia was significantly larger at 5 µg/L in generation F2 and at 2.5 µg/L in generation F3 compared to the control. In the wastewater-borne Ag-NP treatment the adults’ body length was significantly larger at 2.5 µg/L. Thus, adult’s body length showed no consistent pattern between both scenarios. When passing WWTPs most Ag-NPs might be transformed and enter the aquatic environment as silver sulfide. That may be the reason for the lower toxicity than compared to other forms of Ag-NPs. Our results provide a first, direct comparison between the toxicity of pristine Ag-NPs and TiO2-NPs with those from WWTP. To our knowledge, the present study is the first one showing that Ag-NPs from a wastewater treatment plant had a minor and no chronic toxicity to Daphnia magna. The used experimental approach allows a more realistic risk assessment of Ag-NPs and TiO2-NPs for the aquatic environment. The experiment with TiO2-NPs are in progress.

38 Development of a rapid screen to assess bioaccumulation potential: from ex vivo to in vivo using pristine and aged nanomaterials in fish
N. Chau, School of Biological Sciences, Plymouth University; D. Boyle, Plymouth University; R. Handy, University of Plymouth

Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has had little consideration for engineered nanomaterials (ENMs). Given that ENMs undergo surface chemical reactions, agglomeration and sediment, the likely exposure route to higher trophic organisms (e.g., fish) is through the diet. However, addressing the suitability of an in vivo gut sac assay technique to reproduce the bioaccumulation potential of pristine (Ag NPs) and environmentally aged (Ag-S NPs) materials. Additionally, we assess whether the results of the gut sac experiment can predict in vivo chronic dietary exposure. The gut sacs were prepared by removing the entire gastrointestinal tract and separating it into the oesophagus, stomach, anterior, mid and hind intestine compartments. Compartments were exposed by filling the hamen with one of four solutions: physiological gut saline or saline spiked with 1 mg/L Ag as AgNO3, Ag NP or Ag2S NP. Following a 4 h exposure, tissues were cut open and the mucosa was separated from the underlying muscularis, through scraping via a microscope slide. For the in vivo chronic dietary exposure, fish (n = 150) were graded into tanks (n = 3 tank/treatment). Fish were fed either a control (no added Ag), 100 mg/kg as AgNO3, Ag NPs or Ag2S NPs. Fish were sampled each week (1, 2, 3 and 4; n = 2 fish/tank/time point). Following this, all tanks were placed on the control diet for another two weeks to measure Ag elimination. During sampling, the mid and hind intestine, liver, gallbladder, kidney, spleen, gut sacs and carcasses were dissected. Tissues from both experiments were analyzed for total Ag using ICP-MS. The gut sac experiment demonstrated the uptake of Ag is associated with the mid and hind intestine. There was significantly less Ag in the musculi of the mid and hind intestine after exposure to Ag NP and Ag2S NP compared to AgNO3, but no difference between ENM treatments. The in vivo experiment demonstrated significantly more Ag in the mid and hind intestine of Ag NP and Ag2S-NPs compared to AgNO3. Silver from all the exposures were able to pass the gut epithelium and cause total concentrations in the liver to rise, despite the form being unknown. In conclusion, the ex vivo gut sac method can be used to rapidly screen the bioavailability of Ag NPs and Ag2S NPs. However, if the data are ranked in the mid and hind intestine by total Ag accumulation, the gut sac does not directly predict in vivo accumulation.
Transformation of silver nanomaterials by ubiquitous zinc finger peptides


In biological systems, chemical and physical transformations of engineered silver nanomaterials (AgENMs) are mediated, in part, by proteins and other biomolecules. Given the high affinity of thiolate ligands for silver, metalloproteins are key targets to evaluate the role of biomolecules in AgENM transformations. In turn, metalloprotein interactions with AgENMs are also central in mechanistic studies of cellular impacts of AgENMs, including toxicity, antimicrobial, and resistance mechanisms. Despite the shared preference of both silver and zinc for thiolate and amine coordination, the interactions of zinc finger domains with AgENMs is not well studied. Zinc fingers constitute a large class of metalloproteins, ubiquitous in eukaryotes, that use a combination of cysteine and histidine residues that bind Zn(II) as a structural element. Zinc finger domains within proteins typically serve as interactors and can bind DNA, RNA, proteins or small molecules to mediate cellular translation. Studies of AgENM interactions with small libraries of small synthetic peptides, we have evaluated the impact of Zn fingers on AgENMs aggregation and dissolution. Zinc finger peptides drive AgENM dissolution resulting in release of Ag(I) at orders of magnitude higher rates than other model proteins, including a few metalloproteins. The release of Ag(I) is central to mechanisms of cellular response and toxicity of AgENMs. Indeed, Cu(I) binds to both the apoproteins and the Co(II)-substituted peptides; the stoichiometry of Ag(I) binding is dependent on the peptide primary sequence. Additional studies using fluorescence spectroscopy to monitor Ag(I) binding to the Zn finger peptide indicate that the Ag(I) effectively complexes with Zn(II) at the metal binding site, despite the high affinity of Zn(II) for the peptide. Circular dichroism spectroscopy used to assess changes in the peptide secondary structure demonstrate that the addition of either form of silver alters the peptide structure and structural perturbations are again dependent upon the peptide sequence. These results show that Zn finger peptides can mediate AgENM transformations within eukaryotic cells. In turn, for the Zn finger peptides studied here, Ag(I) is the thermodynamically favored metal despite the known high Zn(II) affinity of zinc finger domains. This works suggests that Ag(I)-substituted zinc finger domains might be relevant in the context of both silver toxicity mechanisms and silver-responsive transcription factors.

Fate and effects of transformed Ag and TiO2 nanoparticles aged through a lab-scale wastewater treatment system

A. Georgopoulou, T. Coolbaugh, ExxonMobil Research & Engineering; A. Aziz, ExxonMobil Upstream Research Company; P. Taylor, Petronia Consulting Limited; G. Coelho, Sponso Group Inc.

For several decades, the oil and gas industry has used the Net Environmental Benefits Analysis (NEBA) approach for oil spill response contingency planning. Recently, the International Ocean Response (IOGP) published guidelines on the implementation of NEBA, using a novel process known as Spill Impact Mitigation Assessment (SIMA) to identify the most effective and potentially the lowest additional negative consequences on environmental and social resources. SIMA is both site- and spill-specific, and is particularly useful during the initial planning and preparedness period for oil and gas exploration and production operations. This paper describes a spill impact mitigation assessment framework using recent examples of OSRP conducted for the Arctic Oil Spill Response Technology Joint Industry Project, American Petroleum Institute Gulf of Mexico Deepwater Project, and several companies working in tropical marine environments. The applicability of SIMA to marine resources and habitats is also discussed. The SIMA framework typically includes (a) assessment of initial impacts and potential consequences in the marine environment, (b) effectiveness and consequences of deploying different spill response strategies.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (I)

Mitigation Impact Assessment (SIMA) is a science-based framework evolved from Net Environmental Benefits Analysis (NEBA) to broaden the focus from consideration of mitigation of ecological impact to include mitigation of socioeconomic and cultural impacts, as well. SIMA is a method for identifying and comparing the socio-environmental and -economic benefits of alternative OSR options, with the goal of selecting options that best mitigate the consequences of spilled oil and impose the lowest additional negative consequences on environmental and social resources. SIMA is both site- and spill-specific, and is particularly useful during the initial planning and preparedness period for oil and gas exploration and production when new technologies and best practices emerge that need to be adopted into safety, health and environmental planning and preparedness period. SIMA is a method for identifying and comparing the socio-environmental and -economic benefits of alternative OSR options, with the goal of selecting options that best mitigate the consequences of spilled oil and impose the lowest additional negative consequences on environmental and social resources. SIMA is both site- and spill-specific, and is particularly useful during the initial planning and preparedness period for oil and gas exploration and production when new technologies and best practices emerge that need to be adopted into safety, health and environmental planning and preparedness period.
drawbacks of each option, thereby developing response strategy. Similarly, oil and gas operations are faced with complex options for decommissioning offshore installations as part of their decommissioning plans. There is a need to evaluate these options in a scientifically-defensible and consistent manner, while adequately assessing risks that can be challenging to assess. An adapted SIMA process could be a valuable tool for fostering collaboration between operators, stakeholders and regulators, by ensuring a transparent review of engineering studies and available decommissioning options in a meaningful way. This paper evaluates the use of the SIMA process in a hypothetical decommissioning of an offshore platform to determine if this process lends itself to this purpose. It describes the challenges encountered when trying to conduct this comparative risk assessment, originally intended for oil spill response, to the task of decommissioning. Finally, it proposes adaptations to the SIMA process that might enable its use in the future as a credible tool in assessing environmental risks for oil and gas decommissioning.

45 Detection and quantification of oil contamination in vegetated areas using hyperspectral remote sensing

G. Lassalle, ONERA; S. short, ONERA / Optics and Associated Technologies; A. Credoz, R. Hédaq, TOTAL SA / Environment; P. Borderies, ONERA / DEMR; G. Bertoni, INRA / Dynafor; D. Dubucq, TOTAL SA; A. Elger, University of Toulouse / EcoLab

In the face of oil and gas production, there is a constant challenge in developing new techniques of oil detection for prospection (natural seeps) and environmental monitoring purposes (brownfield). A hyperspectral technique confirmed the potential of this technique for assessing environmental risks deriving from oil and gas production in vegetated areas. It is achieved by extracting information from the spectral signature of vegetation, which corresponds to its reflectance measured by a sensor over multiple, narrow and contiguous wavelengths. Vegetation reflectance is driven by leaf pigments, structures and water content, which can be affected by oil. As a result, the spectral signature of vegetation is modified so it is possible to detect and quantify oil exposure. The final objective of this rapid and non-destructive approach is to be applied on airborne hyperspectral images at high spatial resolution (Rubus fruticosus L.) exposed for 32 days to 25 g.kg\(^{-1}\) of total petroleum hydrocarbons (TPH) from crude oil and mud pits under controlled conditions. Spectral signatures were measured at different scales (leaf, plant and canopy) with a portable spectroradiometer, using a leaf-clip or fixing the sensor above the plant. After 18 days, the signature of TPH-exposed plants was strongly modified. Compared to controls, their reflectance increased in all wavelengths at leaf scale, up to 0.15 greater. The low ground coverage of TPH-exposed plants induced an opposite response in the near- and short-wave infrared (750-2500 nm) at plant and canopy scales. Vegetation indices (VI), computed by reflectance ratio at different wavelengths, were able to discriminate among treatments, and remained robust from leaf to canopy scale. Plant pigments, chlorophyll fluorescence and stomatal conductance were also affected by TPH. The following step was to study the spectral response of the species in situ, in an oil and gas brownfield with the same composition to the original source oil. When we analyses such samples, we may find that these compounds have differential degradation rates in the environment and the "fingerprint" suggests this is static in time. However, it is also well known that triaromatic steranes were also degrading at a significant rate while the oil was at sea and the exposure to UV light may have led to a relatively rapid abiotic transformation. When it comes to distinguishing between sources, less may be more! We need to select the compounds we include in our analyses with care since each question may need a different approach: if we want to know if the oil is weathering, we use a suite of compounds with differential properties appropriate to the environment of the oil. If we want to conduct source apportionment, we may need to choose the most recalcitrant of the compounds rather than all of them.

46 A tool for tracking complex ecotoxicological effect data after large pollution events with use of the Deepwater Horizon oil spill as a case study

J. Beyer, NIVA - Norwegian Institute for Water Research; H.C. Trannum, T. Bakke, Norwegian Institute for Water Research; P.V. Hodson, Queens University / School of Environmental Studies; T.K. Collier, Delta Independent Science Board

The Deepwater Horizon Oil Spill (DWHOS) in 2010 is the largest and most studied accidental marine oil spill in history. More than 100 new research studies concerning the effects of the DWHOS have been published each year since 2011. Key issues investigated include the behaviour and fate of oil in deep spills, the effects on dispersions, microbial oil degradation, oil-affected marine snow formation, oil impacts on deep water corals, seafood quality and safety, oil contaminants effects on fish, birds and marine mammals, effects of combined stressors on species and habitats, and habitat and ecosystem recovery processes. To keep order in this flow of new knowledge is an important albeit challenging task. It is essential that the lessons of DWHOS are applied globally to the task of decommissioning. Finally, it proposes adaptations to the SIMA process that might enable its use in the future as a credible tool in assessing environmental risks for oil and gas decommissioning.

47 Oil spill combat and effects in the Arctic coastal environment; self-cleaning potential and in situ burning

S. Wegeberg, Aarhus University / Department of Bioscience; J. Fritt-Rasmussen, Aarhus University / Department of Bioscience - Arctic Environment; O. Geitner-Hansen, M.R. Larsen, Greenland Institute of Natural Resources; K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment

What is the environmental effects of a beaching oil spill in the Arctic, how well will the shoreline potentially be able to self-clean and will combusting the oil by in situ burning at the coast just do more harm to the communities in the tidal zone? To answer these questions, several studies have been performed at the west coast of Greenland in 2016 and 2017. One aim of the studies was then to support net environmental benefit analysis, NEBA, related to oil spill in Arctic waters. A NEBA is often performed to achieve the optimal environmental effect with respect to choice of oil spill combat methodology and biology at risk. Hence, a synthesis will be presented of following studies: 1) removal rate and ecotoxicological effects of oil smother on seaweed (Fucus distichus), an important organism of the communities in the coastal tidal zone; 2) self-cleaning potential of a coastal line, including natural removal by seawater wash and physical degradation; and 3) effects on the tidal communities after combat of a beaching oil spill by in situ burning. Effects of oil smothering of the macroalgae Fucus distichus, which inhabit the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea were studied over a period of 2 weeks in a field test at Disko Island on the Greenland west coast. Marine snow formation, oil impacts on deep water corals, seafood quality and safety, oil contaminants effects on fish, birds and marine mammals, effects of oil degradation rates in the environment and the pattern changes with period of exposure. It would be more appropriate to use a "signature" analogy when comparing oils by this approach. The weathering processes change the chemical signature and old oil may have a different chemical composition to the original source oil. When we analyses such samples, we may need to ask if this is the same oil as the proposed source, or a different oil with a different signature that is also present. The steranes and terpanes although the concept of a "fingerprint" suggests this is static in time. However, it is also well known that the rate of natural removal and degradation rates in correlation to different water cover regimes and air exposure times were obtained. The oil remains on the tiles were analysed for chemical compositions. A pilot scale costal in situ burning operation was performed during summer in a bay in western Greenland with a crude oil for testing burning efficiency and environmental exposure and effects. The studies were funded by the European Commission Horizon 2020 programme and the Government of Greenland.

48 How stable are our indices? - differentiating between sources in a weathering environment

S.M. Mudge, NILU - Norwegian Institute for Air Research / IMPACT

Crude oil contains many hundreds of compounds and some of these are widely used to differentiate between different oils and products, especially in spill scenarios. Traditionally, we have developed chemical fingerprints based on a suite of compounds such as the steranes and terpanes although the concept of a "fingerprint" suggests this is static in time. However, it is also well known that the rate of natural removal and degradation rates in correlation to different water cover regimes and air exposure times were obtained. The oil remains on the tiles were analysed for chemical compositions. A pilot scale costal in situ burning operation was performed during summer in a bay in western Greenland with a crude oil for testing burning efficiency and environmental exposure and effects. The studies were funded by the European Commission Horizon 2020 programme and the Government of Greenland.

49 Exposure to bisphenol S alters microRNA expression in male zebrafish (Danio rerio)

J. Lee, J. Ji, Yongin University

In response to the restriction of bisphenol A (BPA), bisphenol S (BPS) has been widely used in the manufacturing of polycarbonate plastics and epoxy resins as an alternative compound. BPS has been found to affect reproduction, development, and

Fish model species in human and environmental toxicology (I)

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and immune system. Although microRNAs (miRNAs) play a crucial role in many metabolic activities, whether and how they are involved in the process of BPS-induced toxicity is largely unknown. BPS-induced changes in miRNAs and target gene expression in male zebrafish (*Danio rerio*) gonad, and the potential mechanism was investigated. Male zebrafish were exposed to 0, 5, and 50 µg/L BPS for 21 d. miRNA was isolated from the gonad pool and the expression profiles of 255 known zebrafish miRNAs were analyzed using Affymetrix microarrays. Quantitative real-time PCR was used to confirm the results of miRNA expression analysis. They found that 12 miRNA expression changed in response to BPS exposure, and 6 of these were validated by qRT-PCR. They concluded that miRNA expression changes are likely to be involved in BPS-induced toxicity via the interference with the aromatization process. The results of this study will provide novel insights into the epigenetic regulatory mechanisms of BPS-induced toxicity in male zebrafish.

50 Zebrafish as a model to investigate mechanisms of adverse metabolic and cardiovascular outcomes associated with elevated dietary selenium exposure

D.M. Jang, University of Saskatchewan / Toxicology Centre; C. Pettem, University of Saskatchewan - Toxicology Centre / Toxicology; J. Thomas, University of Saskatchewan Toxicology Centre; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences

A variety of alkaloid-like activities cause increased loading of the essential trace element selenium into aquatic ecosystems, where it poses an extreme toxicological hazard to fishes due to the narrow range between essentiality and toxicity. Although several studies have reported developmental toxicities in early life stages of fishes, fewer studies have investigated sublethal toxicological effects that may occur following dietary selenium exposure in adult fishes. Adult zebrafish were exposed to dietary selenium (0.0, 0.1, and 1.1 µg Se/g food) and environmentally relevant supraphysiological levels (3.4 – 28.8 µg/g) for 90 days. Swimming performance, O₂ consumption and metabolic rates were determined using a swim tunnel respirometer. Cardiac function was assessed using high resolution (30 µm) ultrasound bioclinomicroscopy. Whole-body energy stores (triglycerides and glycogen) and mRNA transcript abundance of selected genes of interest were determined. Compared to controls, adult zebrafish exposed to elevated dietary SeMet exhibited impaired swimming performance (lower fatigue velocity or Ucrit). This was associated with elevated basal metabolic rate and reduced aerobic scope, indicating impaired aerobic capacity. Triglycerides (the primary fuel for aerobic swimming) were elevated in a dose-dependent manner, which was associated with altered transcript abundance of several genes involved in lipid homeostasis. Ultrasonography revealed decreased cardiac output, which was associated with increased echodensity at the atrial-ventricular junction and reduced mRNA expression of the collagenase, MMP2. These results suggest significant ecophysiologiological effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, this study may provide a lead for zebrafish as a model to investigate mechanisms of metabolic, energetic, and cardiovascular toxicities caused by excess dietary Se. Similar responses following selenium overexposure in these results highlight the utility of zebrafish as a model to investigate mechanisms of adverse metabolic and cardiovascular outcomes associated with elevated dietary selenium exposure.

51 Toxicity and neurotoxicity profiling of sediments from Gulf of Bothnia with Danio rerio embryos

R. Massig, Helmholtz Centre for Environmental Research; H. Hollert, RWTH Aachen University / Institute for Environmental Research; M. Krauss, T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; C. Weidauer, Helmholtz Centre for Environmental Research UFZ; P. Haglund, C. Galampois, Umea University; M. Tysklind, Umea University / Department of Chemistry; W. Brack, Helmholtz Centre for Environmental Research UFZ / Environmental Analytical Chemistry.

Sediments are a well-known sink for a large variety of organic pollutants that may cause distress to benthic and pelagic species in case of their remobilization to the water-phase. Risk assessment of complex mixtures may involve component-based approaches applying chemical analysis together with measured or predicted toxicity data of individual components and mixture risk modeling or whole mixture approaches using algorithms that are combinations of both approaches using chemical and bio- analytical tools for characterization for example of sample contamination is expected to provide a more comprehensive picture of toxic risks to aquatic organisms. One of the most promising organisms for diagnostic in vivo testing of sediment may be zebrafish embryos (*Danio rerio*) being a versatile in vivo model suitable for high-throughput analysis while keeping several advantages of in vitro approaches (i.e. low-cost, sensitivity, short duration of the test). The fish embryo test (FET) with *Danio rerio* has been considered as a good surrogate for the acute toxicity fish test and was successfully used in several studies for the detection of toxicity and neurotoxicity in sediments samples. One of the major advantages of the FET with *Danio rerio* is the possibility to monitor several toxic endpoints including the modification of biochemical and molecular processes, which can be related to the exposure of specific pollutants. The present study provides a first attempt to integrate a diagnostic whole mixture assessment workflow based on in vivo toxicological profiling of *Danio rerio* after direct exposure to sediments from Gulf of Bothnia (Sweden) for 4 days. The objectives of the present study was therefore (1) to validate a screening approach for sediment of samples (2) to offer a first in vivo toxicological profile of sediment from three different polluted sites from Gulf of Bothnia.

52 Proteomics based screening tool to detect molecular responses following aromatase inhibition

S.U. Ayobaham, IME Fraunhofer / Department of Aquatic Ecotoxicology; E. Eilebrecht, M. Teigeler, Fraunhofer IME / Ecotoxicology; M. Kotthoff, Fraunhofer IME / Environmental and Food Analysis; S. Kalkhof, University of Applied Sciences Coburg / Department of Bioanalytics; C. Schaefers, Fraunhofer-Institut / Ecotoxicology; H. Hollert, RWTH Aachen University / Institute for Environmental Research.

Chemical exposure to endocrine disruptors can have adverse outcomes on organism health and function; however, the current reliance on end-points such as egg number, plasma VTG content and morphological changes to determine effects of endocrine disrupting chemicals has given rise to series of questions related to chemicals exhibiting similar effects but different mode-of-action (MoA). Identification of the biochemical pathways associated with different toxic responses can be crucial for analyzing, accessing and determining chemical effects. Proteomics, therefore, show appreciable promise as a molecular screening tool for identifying specific alterations between exposures and controls, which is therefore imperative in discriminating endocrine disruptors from substances with a non-endocrine MoA. Such tool waits the need for elongated higher-tier testing. The present study aimed to investigate proteotypic markers that are specific to chemical-induced apical responses in zebrafish. The study focused on fadrozole, a known inhibitor of cytochrome P450 aromatase. Thus an excellent model substance to evaluate and validate proteomic methods with the integration of organ-specific effects. Spawning adult zebrafish (5 males, 5 females) maintained at 25-26°C and 7 L:13 D light/dark cycle; were exposed for 21 days to fadrozole (0.0, 0.1, 1.0 µg/L) and analysed for plasma vitellogenin content, egg numbers and organ histopathology. Livers and gonads were isolated for shotgun proteomics and qPCR to characterize substance induced specific molecular toxicity pathways. Proteins involved in steroid hormone secretion and estrogen stimulus such as vgl1, vgl3, vgl6 and lama1, were significantly deregulated. Several of the prominently affected pathways involved regulation of xenobiotic stimulus, lipid metabolism, metabolic processes, TCA metabolism and calcium signalling. Our study demonstrated that the downstream induced -estrogen receptor suppression by aromatase inhibition triggered the downregulation of estrogen synthesis, which was assumed to induce the observed decrease in egg numbers and oocyte atresia with membrane folding in the ovary. We anticipate that this approach represents a valuable tool for the identification of reliable biomarkers to determine chemical-induced adverse outcomes of ecological relevance in order to avoid unnecessary extensive testing.

53 Zebrafish embryos are able to conduct complex biotransformation processes and activation of chemicals

E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanlaytical Ecotoxicology; B. Seiwert, Helmholtz Centre for Environmental Research- UFZ / Department Analytical Chemistry; S. Speer, Helmholtz centre for environmental research - UFZ / Dept. Bioanalytical Ecotoxicology; S. Brox, Helmholtz centre for environmental research - UFZ / Department Analytical Chemistry; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; Eilebrecht, M. Teigeler, Fraunhofer IME / Ecotoxicology; M. Kotthoff, Fraunhofer IME / Environmental and Food Analysis; S. Kalkhof, University of Applied Sciences Coburg / Department of Bioanalytics; C. Schaefers, Fraunhofer-Institut / Ecotoxicology; H. Hollert, RWTH Aachen University / Institute for Environmental Research.

Zebrafish embryos are proposed and partially already used as replacement for tests with (adult) animals conducted for human and environmental hazard assessment. Zebrafish (adult) animals can have adverse outcomes on organism health and function; however, the current reliance on end-points such as egg number, plasma VTG content and morphological changes to determine effects of endocrine disrupting chemicals has given rise to series of questions related to chemicals exhibiting similar effects but different mode-of-action (MoA). Identification of the biochemical pathways associated with different toxic responses can be crucial for analyzing, accessing and determining chemical effects. Proteomics, therefore, show appreciable promise as a molecular screening tool for identifying specific alterations between exposures and controls, which is therefore imperative in discriminating endocrine disruptors from substances with a non-endocrine MoA. Such tool waits the need for elongated higher-tier testing. The present study aimed to investigate proteotypic markers that are specific to chemical-induced apical responses in zebrafish. The study focused on fadrozole, a known inhibitor of cytochrome P450 aromatase. Thus an excellent model substance to evaluate and validate proteomic methods with the integration of organ-specific effects. Spawning adult zebrafish (5 males, 5 females) maintained at 25-26°C and 7 L:13 D light/dark cycle; were exposed for 21 days to fadrozole (0.0, 0.1, 1.0 µg/L) and analysed for plasma vitellogenin content, egg numbers and organ histopathology. Livers and gonads were isolated for shotgun proteomics and qPCR to characterize substance induced specific molecular toxicity pathways. Proteins involved in steroid hormone secretion and estrogen stimulus such as vgl1, vgl3, vgl6 and lama1, were significantly deregulated. Several of the prominently affected pathways involved regulation of xenobiotic stimulus, lipid metabolism, metabolic processes, TCA metabolism and calcium signalling. Our study demonstrated that the downstream induced -estrogen receptor suppression by aromatase inhibition triggered the downregulation of estrogen synthesis, which was assumed to induce the observed decrease in egg numbers and oocyte atresia with membrane folding in the ovary. We anticipate that this approach represents a valuable tool for the identification of reliable biomarkers to determine chemical-induced adverse outcomes of ecological relevance in order to avoid unnecessary extensive testing.

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activation of organophosphates by comparing the inhibition of acetylcholinesterase (ACHE) activity for the parent compound and the oxon-metabolite in homogenates and intact embryos. For homogenates only the oxon metabolites were able to provoke ACHE inhibition in a concentration dependent manner. In intact embryos inhibition was also found for the parent compounds. The inhibition EC50 was gradually reduced in later stages of embryos, if 24h exposure intervals for different stages were compared. The findings suggest that fish embryos are principally able to activate organophosphates and potentially also other compounds that later embryonic stages may exhibit advanced biotransformation capacity.

54 Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses
C. Rooper, Oregon State University / Department of Environmental and Molecular Toxicology; S. Simonich, Oregon State University / Depts of Chemistry and Environmental Molecular Toxicology; R.L. Tanguay, Oregon State University / Sinnhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

Toxicology research is essential to improve the understanding of the global public health burden of fine particle matter (PM2.5) exposures. However, research groups use differing filter extraction methods to prepare PM2.5 and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM2.5 constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single hi-volume PM2.5 filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM2.5 was then prepared for developmental toxicity testing by collecting the soluble fraction from DMSO extraction. Zebrafish (n=32/treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5 filter portions undergoing filter extraction) starting at 6 hours post fertilization. Aliquots of these PM2.5 solutions were used for chemical constituent analysis of polycyclic aromatic hydrocarbons (PAHs, n=120) and elements (n=20). Significant increases in mortality were observed for PM2.5 from 5 of the 6 filter extraction methods when compared to both the DMSO and blank filter controls. Combined mortality and morphological changes were significantly increased following PM2.5 treatment in all extraction methods compared to DMSO controls. Importantly, two of the methods showed significant mortality and morphological changes with blank filters when compared to DMSO controls. Chemical analysis is underway and differences in PM2.5 solutions between extraction methods will be investigated. Correlations between chemical components and developmental toxicity outcomes will identify compounds that are driving toxicity and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM2.5 filter extraction methods that must be considered when conducting research with complex ambient mixtures. Ultimately, this work identifies extraction procedures for use in this cost-effective surrogate to compare the inherent toxicity differences of PM2.5, and provides a path that will ultimately promote improved understanding of PM2.5-associated health effects.

55 Safeguard and Conservation of Cultural Heritage: the contribution of chemistry

56 Cultural Heritage and Climate Change: impact and adaptation
C. Sabboni, CNR-Istituto di Scienze dell’Atmosfera e del Clima

Cultural heritage, which is a non-renewable resource, is a sector extremely complex for the diversity of materials, structures and systems. The access to citizens and visitors need to be favoured, but at the same time, it is our responsibility to transmit this heritage we received from the past to the future generations. It is urgent to include cultural heritage in the value chain of sustainable development: the priority that faces the world today. Research on the threats that climate change will have on cultural heritage has been very limited until now and it has not yet generated policies designed to mitigate the impact and to develop preventive adaptation strategies. The presentation will be focused on future scenario on the effects of climate change variability on the vulnerability of cultural heritage at European level. Recommendations on the inclusion of cultural heritage in the national adaptation strategies and plans to climate change will also be discussed.

57 Modelling and monitoring of pesticides fate and exposure in a regulatory context (II)

58 Bioicenic residues formation from pesticides - an overview
K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); A. Miltner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; M. Kästner, Helmholtz centre for environmental research - UFZ / Department of Environmental Biotechnology

Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in major amounts to nearly all compartments of the environment. Soils and sediments as complex matrices provide a wide variety of binding sites and are the major sinks for these compounds. Pesticides entering these complex systems may undergo various turnover processes. They can be degraded chemically (e.g. photolysis), biologically by microorganisms, and volatilised leached to the groundwater or taken up by living organisms or immobilised in the form of non-extractable residues (NER). Microorganisms can use C and N from a pesticide to synthesise their biomass compounds, e.g. amino acids (AA) and fatty acids (FA). The extraction of known microbial biomarkers from soil or sediment after addition of C and N isotope tracer allows an estimation of microbial activity in the transformation of pesticide. We investigated the turnover of biocidal herbicides (2,4-D, glyphosate, metamitron, bentazon, bromoxynil and cleodinafop-propargyl) with the particular focus on the metabolic incorporation of the isotope label into AA, FA, and their fate over time. An agricultural soil and water-sediment were incubated with stable isotope labelled respective herbicide in the dark and at constant temperature (20°C). Soil and sediment samples at the respective sampling date were analysed for the amount and isotopic composition of AA, FA, CO2, solvent-extractable parent compound and metabolites and total NER. The presented data indicated that easily biodegradable herbicides e.g. glyphosate, 2,4-D or metamitron were utilized as a carbon (and building materials. Specifically, a surfactant-assisted sol-gel synthesis to produce, in-situ on the building, crack-free nanomaterials to be used as long-term consolidants. Additionally, hydrophobic, water-repellent, self-cleaning, and biocidal properties can be incorporated into the product by innovative chemical modifications of the proposed synthesis route. Finally, I will summarize the future challenges of our group related to conservation of historic concrete in the framework of the Horizon 2020 project “InnovaConcrete”.

59 Towards the European Research Infrastructure in Heritage Science: E-RHIS
L. Pezzati, CNR-Istituto Nazionale di Ottica

The European Research Infrastructure for Heritage Science (E-RHIS) entered the European strategic roadmapping process (ESFRI Roadmap) in 2016, as one of the six new projects. E-RHIS support research on heritage interpretation, preservation, documentation and management. Both cultural and natural heritage are addressed: collections, buildings, archaeological sites, digital and intangible heritage. E-RHIS is a distributed research infrastructure with a multi-level star-structure: facilities from many Countries will be organized in national networks, coordinated by several National Hubs and RIHS headquarters will provide the unique ex-point to all E-RHIS services, by coordinating the net of National Hubs.

60 Scenario Development for Off-field Soil Exposure and Risk Assessment
M. Wang, WSC Scientific GmbH / Dept Etafe Modelling; J. Kleinnann, WSC Scientific GmbH; T. Schad, Bayer Ag / Environmental Modelling; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; G. Ernst, Bayer Ag / Ecotoxicology; G. Goerlitz, Bayer CropScience AG / Environmental Safety; P. Neumann, Buyer Ag; S. Bub, Trier Solutions GmbH

In its Scientific Opinion on risk assessment for in-soil organisms EFSA proposes a preliminary approach for off-field soil exposure by adding up entries from the different major exposure routes. EFSA indicates the worst-case character of its scenario “In the absence of appropriate off-field exposure scenarios…” and, hence, emphasises the necessity for model and scenario development. The present work aims to undertake first steps (i) to develop a model approach for off-field/for crop soil exposure due to runoff, erosion, and drift, (ii) to develop exemplary schematic and real-world scenarios, (iii) which allow to gain insights in off-field soil exposure and risk using case studies. The developments are based on the Specific Protection Goals options. A tiered modelling approach is presented which allows to build exposure scenarios ranging from simple schematic and conservative to more realistic landscape-scale tiers, which can be easily linked to effect modelling (toxicological, population, community). Results are intended to support the design of off-field soil exposure and risk characterisation scenarios and the development of assessment endpoints relevant to address SPGs.

61 Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses
C. Rooper, Oregon State University / Department of Environmental and Molecular Toxicology; S. Simonich, Oregon State University / Depts of Chemistry and Environmental Molecular Toxicology; R.L. Tanguay, Oregon State University / Sinnhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

Toxicology research is essential to improve the understanding of the global public health burden of fine particle matter (PM2.5) exposures. However, research groups use differing filter extraction methods to prepare PM2.5 and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM2.5 constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single hi-volume PM2.5 filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM2.5 was then prepared for developmental toxicity testing by collecting the soluble fraction from DMSO extraction. Zebrafish (n=32/treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5 filter portions undergoing filter extraction) starting at 6 hours post fertilization. Aliquots of these PM2.5 solutions were used for chemical constituent analysis of polycyclic aromatic hydrocarbons (PAHs, n=120) and elements (n=20). Significant increases in mortality were observed for PM2.5 from 5 of the 6 filter extraction methods when compared to both the DMSO and blank filter controls. Combined mortality and morphological changes were significantly increased following PM2.5 treatment in all extraction methods compared to DMSO controls. Importantly, two of the methods showed significant mortality and morphological changes with blank filters when compared to DMSO controls. Chemical analysis is underway and differences in PM2.5 solutions between extraction methods will be investigated. Correlations between chemical components and developmental toxicity outcomes will identify compounds that are driving toxicity and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM2.5 filter extraction methods that must be considered when conducting research with complex ambient mixtures. Ultimately, this work identifies extraction procedures for use in this cost-effective surrogate to compare the inherent toxicity differences of PM2.5, and provides a path that will ultimately promote improved understanding of PM2.5-associated health effects.
nitrogen) source and the NER were mainly biogenic. The major formation of biogenic residues is supposed to be relevant for easily biodegradable contaminants under significant CO₂ formation. However, in the case of more recalcitrant pesticides like bentazone, the incorporation of C into microbial biomass, although reported to be very low, cannot be completely excluded.

61 Derivation of a foliar wash-off factor for FOCUS modelling based on literature research S. Sittig, DR. KNOELL CONSULT GmbH / E-Fate Modelling; C. Wollmann, Dr Knoell Consult GmbH; G. Reinen, Bayer AG, Research & Development, Crop Science / Environmental Safety

After foliar application, plant protection products (PPP) undergo several rounds of dissipation of which one is precipitation-induced wash-off from the canopy. This process is accounted for in the European exposure assessment framework for PPP authorization and included in the corresponding numerical models, e.g. FOCUS PEARL, PELOM, PRZM and MACRO. A numerical wash-off factor for modelling is applied, quantifying the wash-off from plant surfaces by a given amount of precipitation. Consequently, this factor is relevant for the calculation of predicted environmental concentrations (PEC) for the compartments soil, groundwater, and surface water. In case a measured wash-off factor is not available, a default value is to be applied. An increase of this default value from 0.5 cm⁻¹ to 1 cm⁻¹ has been proposed by EFSAs, which results in more exhaustive wash-off from the plant surface. Generally, the extent of rainfall-induced dissolved substance depends on several factors. An ECPA working group recommended a harmonized experimental approach to derive wash-off factors in the greenhouse: a 24th time interval between pesticide spraying and 10 to 20 mm of artificial rain, followed by an explanation of the plant material with an acetonitril/water mixture of 80:20 (v/v). This standardized experimental procedure has been defined in order to derive a reliable numerical wash-off factor as input for FOCUS modelling. In this study, the performed literature was reviewed for the availability of data suit for the calculation of a wash-off factor, reflecting a variety of different investigation types in terms of time of artificial rainfall after application, rainfall amount and intensity, formulation, crops under investigation, etc. Published experimental wash-off studies are usually not conducted according to the standardized experimental procedures. Thus, only a limited number of the published studies are suitable to derive a wash-off factor for modelling. The outcome of the literature review presented herein suggests that a meaningful default wash-off factor should be well below 1 cm⁻¹. Keeping the existing default value of 0.5 cm⁻¹ retains a sufficient protection level while at the same time avoids a large number of unnecessary refinement studies.


In a regulatory setting, the potential for bioaccumulation and biomagnification of plant protection product active substances in aquatic organisms is evaluated with simple screens on the basis of a substances’ log Kow, where typically a value greater than or equal to 3 indicates concern. However, this criterion may lead to false positive identification, because it does not account for biotransformation of the substance in aquatic or biotic/abiotic systems. Dynamic aquatic food web models are more refined tools for determining bioaccumulation and biomagnification potential, because they can account for chemical bioavailability and temporal and spatial variability in exposure concentrations due to seasonal and regional differences in weather and agricultural practices. The aim of this work is to demonstrate a modelling approach that couples standard FOCUS landscape and water body models with a dynamic aquatic food web model to assess whether a hydrophobic insecticide with logKow above the screening threshold of 3 will bioaccumulate/biomagnify. The Simon Fraser University (SFU) aquatic food web model, which predicts chemical concentrations in biota at six different trophic levels within an aquatic ecosystem, was selected based on the availability of data for relatively few input parameters and its demonstrated capability to predict observed chemical concentrations for a wide range of species, chemicals, and aquatic environments. To maximize relevance for agricultural systems in Europe, the food web model was adapted to accept environmental concentration time series input from the established TOXSWA model used in EU pesticide registration procedures. The modelling approach leveraged the transient form of the aquatic foodweb models, which are time-varying and/or stochastic in agricultural settings. Modelling results included both the daily time series predictions of organism concentrations for the six trophic levels and the uptake and elimination rate constants calculated from organism sub-models. In total, nine FOCUS scenarios were simulated and compared (five drainage scenarios with MACRO and four runoff scenarios with PRZM) and dominant organism uptake pathways were identified. The approach may be used to refine log Kow-based screening bioaccumulation and biomagnification evaluations for regulatory purposes.

63 Improved assessment of pesticide peak exposure in cultivated mountain watersheds M. Morselli, University of Insubria / Department of Science and High Technology; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como; A. Di Guardo, University of Insubria / Department of Science and High Technology

Agricultural activities can involve the use of plant protection products (PPPs) and the use of such chemicals can occur near surface waters bodies, thus creating a potential for adverse effects on aquatic ecosystems. Due to the spatio-temporal variability of chemical applications and of the processes regulating their fate and transport to surface waters, ecosystems are often exposed to pulses of contaminants. In In certain environmental scenarios, such as small mountain watersheds, where runoff fluxes are particularly rapid due to side slopes, exposure peaks can be shorter but much higher. Monitoring campaigns are often inadequate or too expensive to be carried out and modelling tools are therefore vital for exposure assessment and their use is encouraged by current legislation. However, currently adopted models and scenarios (e.g. FOCUS for PPPs) are often too conservative and/or “static” to accurately capture exposure variability, and the need for more realistic and dynamic tools is now one of the major challenges for risk assessment. In a previous work, the new fate model DynAPlus was developed to improve pesticide fate predictions in cultivated mountain basins. The model was successfully evaluated against chlorpyrifos water concentrations measured in the Novella River (Non Valley, Northern Italy), where more than 1000 ha of apple orchards surround the river and are cultivated by many farmers. However, need for some model improvements and application to other chemicals and scenarios was highlighted. In this work, the DynAPlus model was improved to increase realism, by including vegetation to both terrestrial and aquatic environments, dissolved organic carbon (DOC) in water, and a soil-erosion module to compute particle-mediated chemical transport to surface waters. The improved DynANet was first applied to the Novella River case study and the new model was parameterized to simulate another cultivated mountain basin located in Northern Italy and applied to simulate the fate of three pesticides with different physical-chemical properties and persistence. The resulting peak exposure profiles were discussed to highlight the added value of such a dynamic modelling approach in providing information on exposure which could not emerge from the application of current approaches.

64 Implementation of mitigation measures and assessment of its impact under field-specific environmental conditions in the risk indicator SYNOBS-WEB for Norway A. Dominic, Julius Kuehn Institute / Institute for Strategies and Technology Assessment; O. Eklo, Norwegian Institute of Bioeconomy Research NIBIO / Department of Pesticides and Natural Products Chemistry; M. Stenrod, Norwegian Institute of Bioeconomy Research (NIBIO); E. Solbakken, R. Lagbu, Norwegian Institute of Bioeconomy Research (NIBIO); J. Skjenke, Julius Kühn-Institute, D. Falchamow, Julius Kühn-Institute / Institute for Strategies and Technology Assessment; B. Golla, Julius Kuehn Institute / Institute for Strategies and Technology Assessment; J. Strassemeyer, ral Research Centre for Cultivated Plants / Institute for Strategies and Technology Assessment

In response to the implementation of the EU-directive on sustainable pesticide use in agriculture, the project SMARTCROP (funded by the Research Council of Norway), was started to address the challenges of developing and providing farmers with the necessary IPM tools. Towards this objective, SYNOBS, a risk indicator developed by the Julius-Kühn Institut, Germany, was adapted for Norway and provided with a graphical user interface such that a farmer or non-expert could perform risk assessments for field-specific pesticide applications. US-EPA PRZMS and VFSMDO have been incorporated in SYNOBS for a more realistic modelling of the runoff/erosion modules and the functioning of the vegetated filter strip. The Norwegian tool, SYNOBS-WEB, is available in both English and Norwegian. It uses Norwegian land-use, surface water and soil data, plant protection products registered for use in Norway, modified crop data for Norwegian conditions, and station-based weather data. Dynamic aquatic environments are modelled to allow for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tile/gulch, and cover crops. Risk assessments can be performed for a combination of mitigation measures in order to select the optimal application strategy under specific field conditions. In this presentation, we describe the mitigation measures implemented in SYNOBS-WEB, Norway, and the corresponding adjustments to the model input parameters. We provide example scenarios based on realistic application patterns, without and with mitigation measures. Aquatic and terrestrial risk indices are presented to the user as Exposure Toxicity Ratios (ETR) in the form of colour-coded tables for an easy visual appraisal of the environmental risk under different conditions. In addition the predicted environmental concentrations can be viewed on a daily basis for the selected time period.

Hydrophobic Chemicals and Mixtures: Reliable Investigations
on their Environmental Fate and Effects (II)

65 Acute Toxicity of Pyrene Associated with Dissolved Organic Matter of Various Molecular Weights to Daphnia magna

H. Lin, X. Xia, S. Bi, X. Jiang, H. Wang, W. Wen, School of Environment, Beijing Normal University

Dissolved organic matter (DOM) is a key environmental factor for the toxicity of hydrophobic organic compounds (HOCs) in natural waters. However, the toxicity of DOM-associated HOCs is still not clear. In this research, pyrene was selected as a model HOC and six dissolved organic compounds (DOM) was measured. The toxicity of pyrene was evaluated using passive dosing systems. The immobilization and enzymatic activities of Daphnia magna were examined to analyze the toxicity of DOM-associated pyrene. The results indicated that the immobilization of Daphnia magna in the systems containing various molecular weight DOM and pyrene was ordered as middle molecular weight (MMW; 5–10k Da) DOM > higher molecular weight (HMW; > 10k Da) DOM > DOM with low molecular weight (MMW; < 3k Da, 1–3k Da, and 3–5k Da) DOM. Furthermore, the superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD) activity of Daphnia magna decreased gradually with the increasing C\textsubscript{DOM} in the systems of MMW and HMW DOM, whereas increased when C\textsubscript{DOM} was at a low level and then decreased when C\textsubscript{DOM} was at a higher level in the control group with pyrene only and the system of LMW DOM. The influencing factors from the DOM associated pyrene to Daphnia magna were related with the amount of pyrene sorbed on DOM, the uptake routes of DOM by Daphnia magna, and the desorption of pyrene from DOM in the gut of Daphnia magna. The findings obtained in this research suggest that the toxicity of DOM-associated HOCs should be taken into account for the eco-environmental risk assessment of HOCs in water systems.

66 Passive dosing for constant concentration and defined composition of hydrophobic organic mixtures

K. Hennemann, Department of Environmental Engineering; H. Birch, DTU Environment / Department of Environmental Engineering; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

There is regulatory and scientific attention on the fate, exposure and effects of chemical mixtures including complex mixtures of hydrophobic chemicals as petroleum substances and essential oils. These mixtures have recently been categorized as multicomponent substances and substances of unknown or variable composition, complex reaction products or biological materials (UVCBSs). The dosing of such mixtures in environmental experiments and tests can be challenging and there is an urgent need for new methods to provide stable concentrations and defined composition of these mixtures in aquatic fate and toxicity testing. Passive dosing from silicone rods has successfully been used in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of K\textsubscript{ow} and K\textsubscript{oc}. This study aims to extend the applicability of the novel passive dosing method to hydrophobic multicomponent substances and UVCBs (i.e. complex mixtures). The method is straightforward: a silicone rod is loaded by direct addition with ultrapure water to create constant and defined concentrations of each mixture constituent and thus also a constant and defined mixture composition. The aqueous concentration level can be controlled by the amount of mixture added to the rod. Early results show a good performance of the method with very fast dosing kinetics, aqueous concentrations increasing linearly with loading level and good reproducibility of the passive dosing for a petroleum substance and an essential oil. The presentation will focus on (1) the fast and reproducible loading of selected UVCB mixtures, (2) reproducibility and optimized passive dosing kinetics for one petroleum substance and one essential oil and 3) the performance and characteristics of the passive dosing method compared with more traditional dosing methods.

67 Biodegradation of volatile substances in soil - Challenges and optimization of test setups (OECD 307)


Higher tier biodegradation laboratory tests in soil, sediment and/or surface water systems are conducted using standard OECD guidelines. As stated in these guidelines, they are not suitable for testing volatile chemicals, however a threshold based on Henry’s law is not defined, except in OECD 309. In the actual setups, incomplete mass balance is a major problem while testing volatile chemicals. Optionally, OECD 307 and 308 allow biometer-type incubation setups but it does not require any data to prove if the systems remains aerobic. In addition, the degradation kinetics in a closed test system can largely be influenced by air-water partitioning as described by Birch et al. 2017. Our objective was to design a closed incubation test set up where maintaining and measuring of aerobic conditions was possible without the loss of test chemical. Additionally, a full scale OECD 307 with two model chemicals was performed to check the reproducibility of data in terms of mass balance and to better understand the obtained degradation data. The test setup consisted of 100 mL flask with 50g soil, CO\textsubscript{2}-trap and a Tenax tube completely closed using a stainless steel lock system. Oxygen saturation in the headspace was measured in a reference sample using optical measurements without the need to open the vessel. If the oxygen saturation was < 15%, the samples was aerated with oxygen-rich air. Applying this setup, degradation of 1\textsuperscript{4}C-labelled Tetralin and Decane was conducted on soils with different texture, organic carbon and microbial activity. At sampling dates the headspace air of the samples was stripped off through the Tenax tube using a vacuum pump. The Tenax tube and the CO\textsubscript{2}-trap were taken for analysis and the soil was taken for extraction using appropriate methods. The solid extraction residue was subject to combustion analysis to determine the non-extractable residues (NER). The average overall recovery of 99.29% (N=4) for Decane and 104.34% (N=4) for Tetralin with a variation (between the individual replicates) < 11% for both studies suggests that obtaining a complete mass balance with the new test setup was reproducible. It was observed that radioactivity adsorbed on Tenax (100% parent), was higher in the soils with lower OC content suggesting that sorption of the chemical affecting its volatilization and hence degradation. Thus, how to deal with the volatilized parent fraction while calculating degradation kinetics is still a part of ongoing research.

68 Untangling the biodegradation of hydrophobic chemicals in OECD and novel tests using a unified modelling approach

F. Pohle, Technical University of Denmark (DTU) / DTU Environment; A. Bjerg, DTU Environment / DTU Environment; F. Stibany, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaefeer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Kästner, Helmholtz centre for environmental research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU / DTU Environment

Persistence assessment using standardized (e.g., OECD) tests is one of the main challenges for hydrophobic organic chemicals (HOCs). While the use of radiolabeled chemicals brought major advances, mechanistic models can still provide deeper insights in experimental results and underlying processes. In this context, the key objective of this study was to test the applicability of a unified modelling approach across the spectrum of OECD degradation tests and newly developed experimental tests for HOCs. We specifically aimed at (i) elucidating biodegradation kinetics and improving their estimation by including a new method for microbial yield calculation; (ii) determining 1\textsuperscript{4}C fractions (mineralized, incorporated in biomass and non-extractable residue NER) at the end of tests as persistence indicators. The unified model for sorption and biodegradation (in combination with the Microbial Turnover to Biomass growth yield estimation method) was used to predict mineralization to CO\textsubscript{2}, growth of degrading microorganisms and NER formation in aerobic degradation tests with selected 1\textsuperscript{4}C-labeled HOCs (triclosan, pentachlorophenol—PCP, propargite and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradation tests activated sludge or soil or in novel passive dosing setups, in the presence of a single degrader strain. Overall, good agreement between model predictions and empirical data was shown by adjusting only the ratio \textit{v}_{\textit{max}} / \textit{Kc}, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of \textit{v}_{\textit{max}} / Kc values was shown for the selected substances (0—55 \textit{mg} \textsuperscript{2} \textit{d} \textsuperscript{-2}), indicating that both limited bioavailability and intrinsic recalcitrance can explain HOC persistence. This study represents a first attempt of using a unified modelling approach for predicting biodegradation of HOCs across a variety of tests, showing promising results towards persistence prediction of organic chemicals during regulatory screening. Ongoing research is focusing on extending the model applicability by (i) including the formation of intermediate transformation products; (ii) determining (de)sorption limitation based on dedicated experiments; and (iii) using uncertainty-based approaches to support decision makers within REACH.

69 History of polychlorinated biphenyl deposition to snow and ice from the Lomonosovfonna glacier, Svalbard

M. Garmash, University of Helsinki; E. Isaksson, Norwegian Polar Institute; C. Lomonosovfonna glacier, Svalbard.

Lomonosovfonna glacier on Svalbard from an ice core drilled in 2009, and a snow transect across a variety of tests, showing promising results towards persistence prediction of organic chemicals during regulatory screening. Ongoing research is focusing on extending the model applicability by (i) including the formation of intermediate transformation products; (ii) determining (de)sorption limitation based on dedicated experiments; and (iii) using uncertainty-based approaches to support decision makers within REACH.

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distances, and do not include any local PCB sources on Svalbard. Total PCB deposition history to the core and surface snow shows that amounts have not declined in net amount since the mid 1950s. The peak flux in the surface snow and to ice core layer is 18.5 - 19 pg cm-2 yr-1. Average 5-day air mass back trajectories from peak flux periods beginning in 1998 show more frequent 5-day air mass trajectories from Russia, and from Europe south of 600 N latitude, particularly extending into the U. K., relative to 1899-1998, which had 5-day trajectories ending in the far north of Russia and Norway. The surface snow PCB concentration profile is dominated by PCB 110, 74,70, 101, 95, 11. Combined, these five congeners represent ~72% of PCB. The upper-most ice core sample is dominated by PCB 95, 52, 101, 70,74, which represent ~42% of PCB. The most apparent difference between the two profiles is the lower amount of dichloro- and trichloro- congeners in the ice core compared to the surface snow (Figure 1B). The indiction is that the more volatile congeners in the dichloro- and trichloro- homologues are deposited to surface snow shown in Figure 1A, but are volatilized back to the atmosphere during periods of higher summer air temperature. The percent of PCB-111 throughout the samples ranges from 0.90-3.4% and is present in all samples dating from 1957. It is the dominant congener among mono- and di-chloro PCBs. This PCB congener has very low or no presence in Aroclor products, and apparently is not found in other PCB parent mixtures. Its source is often considered to dairylide yellow pigment or products containing it. Its presence in the environment is sometimes associated with disposal of products containing this pigment. The source of PCB-111 to Lomonossofonna is uncertain, but could be waste incineration facilities in Europe where it has been found in flue gas.

Environmental occurrence and distribution of organic UV stabilizers in the sediment of the Bohai and Yellow Seas C. Apel, Helmholtz-Zentrum Geesthacht; J. Tang, Yantai Institute of Coastal Zone Research, CAS; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemicals; Z. Eteng, Zentrum Geesthacht; J. Tang, Yantai Institute of Coastal Zone Research, CAS; Y. Wang, China. Organic UV stabilizers are of environmental concern due to their large production volumes and potential endocrine disrupting properties. UV stabilizers are widely used in plastic products, paints and coatings to improve the product stability against UV light. Furthermore, some UV stabilizers are approved as ingredients in personal care products like cosmetics and sunscreens. The pathways into the marine environment are either indirect by wastewater treatment plant discharges or direct by recreational activities like bathing and swimming. Four benzoiazole UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous others are currently listed under the European community rolling action plan (CoRAP) to be (re)-evaluated in the next years. Due to their chemical properties, most UV stabilizers accumulate in the marine environment and are released to the environment by biodegradation processes. The aim of this study is to evaluate the occurrence of different UV stabilizers in sediment samples of the Bohai and Yellow Seas. The study was conducted in collaboration with an aquatic monitoring project. Environmental data for the coastal and marine environment are sparse. For this study 74 surface sediment samples of the Bohai and Yellow Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as follows: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, DIONEX, Germany) method. For this, 22 mL stainless steel ASE cells were filled with 3 g of 10% deactivated silica and approximately 5 g sediment that was spiked with appropriate isotopically labelled standards. The cells were extracted using dichloromethane for three 15 min-cycles at 100 °C. The extracts were solvent-changed to methanol, reduced in volume to 150 µL. The subsequent 2 µL of the extract was performed on a LC/MS/MS system (LTQ-XL, Thermo Fisher Scientific). For analysis, a combination of three different methods was applied: (i) generic scores and (iv) irrespective of the chemical substance categories (e.g. toxicity) consideration of best performing villages in terms of total damage to human health and ecosystems; although village performing worst with regard to total damage to human health changed. There was a general tendency that biochar production using both Kon Tiki and Adam retort kilns performed better than earth-mound kiln, and furthermore biochars brought largest benefits where no-biochar agricultural production systems were based on inorganic fertilizers. This rather consistent ranking was mainly due to relatively large geographic differences in life cycle inventories between villages, which were often larger than geographic differences in characterization factors between site-specific and site-adaptive approaches. Thus, although spatial differentiation improved accuracy and realism of environmental impacts in this comparative case study, it did not necessarily contribute to more correct decisions.

Considering space debris related impacts within the LCIA framework T. Maury, University of Bordeaux / ISM-CyVi; P. Loubet, CyVi-ISM / ISM CyVi; A. Gallice, ArianeGroup / Design for Environment; G. Sonnemann, University of Bordeaux / ISM CyVi; M. Sparrevik, M. Hanssen, University of Bergen / ISM CyVi; M. Sparrevik, M. Hanssen, University of Bergen / ISM CyVi. The space sector is a new area of development for LCA studies. The European Space Agency (ESA) has been working since 2012 on environmental issues for space activities through its Clean Space Initiative. ArianeGroup, which is the prime contractor for the development of the new Ariane 6, is currently performing an LCA of this launcher in exploitation phase (ESA’s contractual requirement). However, the current studies adopt a Cradle-to-Lauchpad approach due to lack of relevant modelling for use and disposal phase. In addition, a rising sustainability concern is occurring in the space sector particularly regarding impact of space debris: 29,000 human-made objects, larger than 10cm, are orbiting the Earth but only 6% are operational spacecraft, being today a significant and constant danger for all space missions. Consequently, considering end-of-life management during the design of spacecraft becomes a sustainability concern. Given this situation, there is an opportunity to make the link between space debris concern and eco-design of spacecraft (satellites & launchers) using the LCA methodology. A focus should be put on the comparison of several missions & post-mission disposal scenarios to study potential trade-offs between typical impact categories (e.g. toxicity and climate change), but also with regard to the growing issue of space debris. Hence, our challenge is to integrate, via a dedicated additional indicator, space debris related impacts within the LCIA to broaden the scope of LCA for space systems. The Area-of-Protection Resources has been identified to reflect the depletion of available orbits by the potential generation of space debris. Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s design and operation. Volume occupation by debris and dead spacecraft leads to a decrease of the orbital resource availability enhancing the risk of collision/break-up and then propagation of new clouds of debris. As a consequence, the lack of access to the orbital resource in the future (scarcity) could be handled as environmental and socio-economic impacts. The presentation will prove the relevancy of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

Implementing ozone formation effects due to poplar plantations for biomass production in Europe: An LCA impact assessment P. Vercoulen, Radboud University; C. Hendriks, TNO; R. Van Zelm, Radboud University / Department of Environmental Science. Poplar trees are known to emit volatile organic compounds, among them isoprene, which enhances tropospheric ozone formation. Ozone exposure, in turn, causes adverse effects to human health and ecosystems. In the context of an energy transition, it has been proposed to use poplar biomass to produce bioenergy via electricity. The goal of this research was to determine country specific characterization factors (CFs) for ecosystem damage due to ozone formation from isoprene emissions caused by poplar tree plantations in Europe. CFs were defined as the change in potentially affected fraction of plant species (PAF) due to a change in the country-specific poplar plantation area (in km²)ryr/km²rpyr) and consists of a factor and an effect factor. To determine the fate factor, changes in Accumulated Ozone over a Threshold of 40 ppb (AOT40) in all grid cells connected to isoprene emissions resulting from additional poplar plantations on 1% of agricultural land in each country were estimated with chemistry transport model.
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (II)

77 Review on removal and reactions of micropollutants in biofilms under growth and non-growth conditions

K. Bester, Aarhus University / Environmental Science; M. Escolà Casas, Aarhus University / Department of Environmental Sciences; U. Bollmann, Aarhus University / Environmental Science; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; E. Toreesi, Kruger A/S; H. EI-talawiy, Aarhus University / Department of Environmental Science; L. Zhang, Aarhus University / Department of Bioscience; G. Ooi, K. Tang, DTU Environment; H.R. Andersen, Technical University of Denmark / Department of Environmental Engineering; M. Christensson, Anox Kaldnes Pharmaceuticals and other compounds need to be removed from wastewater. This contribution will give an overview on the possibilities of removing micropollutants with biofilms. Biofilms occur in nature, but are also increasingly used in technical installations to remove micropollutants from water (wastewater and drinking water), porous media biofilm systems (sandfiltrers), moving bed biofilm systems (MBBRs). Biofilms can remove considerably better than suspended bacteria: diclofenac is recalcitrant in sludge systems, while it can be degraded with half-lives of ca. 2 h in biofilms. In this contribution it is highlighted which ecological conditions (aerated versus denitrifying; high and low BOD loads) have been found to favor degradations. It was found that BOD supply has massive impact on the removal: On the one hand high BOD loads led to enhanced growth of biofilm, resulting in high turnover and reaction rates also of the respective micropollutants. On the other hand the biomass related reaction rate constants are considerably higher with low BOD loads. The highest reaction rate constants and biomass related reaction rate constants were found for systems with intermittent BOD loading. The switch from aerated to denitrifying conditions, however only gives effects for a chosen few compounds like ibuprofen, while reaction rates usually are similar. So the redox conditions as such are obviously not critical. Biofilms have often proven to have unique degradation pathways leading to hitherto strange metabolites. On the other hand compounds that were hitherto believed to be recalcitrant (like diclofenac) could easily be degraded in relatively short time periods. For single compounds degradation pathways for biofilm systems are discussed and compared to other systems. While oxidation pathways are relatively common it seems like biofilms often perform a combination of oxidation and sulfatation pathways. Interestingly enough, it was possible to reach high removal rates for otherwise persistent ozonation-by-products such as macrolide N oxides while avoiding back reactions to the parents with a moving bed biofilm reactor (MBBR). This also holds for most of the ozonation products of diclofenac.

78 Biodegradation of emerging organic contaminants using an enzyme-mediator system and study of the resulting transformation products

I. Caraene, Curtin University / chemical department; C. Joll, Curtin University / chemical department; K. Linge, Y. Gruchlik, Curtin University; A. Paparini, Murdoch University

Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmaceutically active compounds, personal care products, pesticides, surfactants, plasticizers, corrosion inhibitors, flame retardants, artificial sweeteners and others) have been identified in the aquatic environment. Biodegradation is one of the processes that can remove potentially hazardous emerging organic contaminants from different environments, with the help of microorganisms (e.g. algae, bacteria or fungi) and their extracellular products, in both aerobic and anaerobic conditions. The objective of this study was to investigate the biodegradation of a series of antibiotics and one anticonvulsant using laccase enzyme, extracted from a white-rot fungi Trametes Versicolor, in the presence of 2,3′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammnonium salt (ABTS), as a mediator. The experiments were conducted in MilliQ water at different pH values, with different ratios of laccase and mediator, under aerobic and static conditions. The degradation was monitored by measuring the concentration of the remaining antibiotic over 168 hours, using a high performance liquid chromatograph with UV detection. The formation of new peaks was also monitored
and high resolution mass spectrometry (HRMS, LTQ Orbitrap) was used to identify potential transformation products. Furthermore, the microbial activity of the antibiotics and their transformation products was assessed, using an E. coli culture and microbial disks. Results showed that 89% degradation of sulfamethoxazole could be achieved at pH=5, with an enzyme activity ranging between 110-120 U/L and an initial mediator concentration of 200 μM, while trimethoprim only degraded by 43% under the same conditions. The results of similar radiation experiments on other antibiotics will be discussed in this conference presentation. The identification of transformation products of the antibiotics using high resolution mass spectrometry, and the microbial activity of the transformation products, will also be presented. This study provides a better understanding of the biodegradation of emerging organic contaminants and their transformation products. Further work confirms the reassessing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

79 Evaluation of macro and microbatic transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays

S. Terzić, Rudjer Boskovac Institute / Division for Marine and Environmental Research; P. Kostanjevecki, I. Krijman-Mačaši, I. Senta, Rudjer Boskovac Institute; T. Jurina, Faculty for Food Technology and Biotechnology; N. Udiković-Kolic, Rudjer Boskovac Institute; J.Čurko, Faculty of Food Technology and ERY TPs; M. Matosic, Faculty for Food Technology and Biotechnology; J. Lončar, I. Mihaļjevič, T. Smital, Rudjer Boskovac Institute; M. Aheλ, Rudjer Boskovac Institute / Division for Marine and Environmental Research

The aim of the present study was to investigate the transformation of three prominent representatives of macrolide antibiotics (azithromycin - AZI, clarithromycin - CLA and erythromycin - ERY) in model biodegradation and ozonation experiments. The study included determination of the dissipation kinetics of the parent compounds, identification of transformation products and ecotoxicological evaluation of transformation processes using two different end-points. The biodegradation efficiency was studied using the sludge culture enriched in the presence of AZI (10 mg/L) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. Antibiotic activity test was based on the inhibition of bacterial growth (Bacillus subtilis), while toxicity test was performed with the freshwater green algae Desmodesmus subspicatus. At the applied experimental conditions, both biodegradation and ozonation experiments resulted in nearly full elimination of the tested parent compounds. The biotic and abiotic removal of all parent compounds was associated with the formation of different TPs, some of which were rather abundant and persistent to further degradation. The highest number of detected TPs was associated with the elimination of AZI, while the number of CLA and ERY TPs was lower. The capability of the studied microbial community to degrade these antibiotics was confirmed in various environmental samples. The ecotoxicity of the biodegradation and ozonation processes was assessed using microalgae and zooplankton. The results indicated the absence of toxicity to these biotic models. The availability of a long-term study with the same conditions is therefore aimed at monitoring of the three antibiotics and their TPs in natural and treated waters.

80 DI-SPME - On-fiber Derivatization - GC-MS. An innovative green and cost-effective approach to determine CECs and TPs from a novel anoxic-aerobic photobioreactor

R. López-Serna, University of Valladolid / Chemical Engineering and Environmental Technology; E. Posadas, P.A. García-Encina, R. Muñoz, University of Valladolid

The demand of multicomponent methods for the analysis of compounds of emerging concern is continuously increasing. Conventional techniques are time consuming and expensive. However, conventional techniques based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) are very often only available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the extraction, GC-MS analysis, and UHPLC-DAD characterization of CECs and TPs, in sewage and sludge using a fully automatized online DI-SPME – On-fiber Derivatization – GC-MS. The validated method was proven to be reliable, thanks to the combination of two quantification approaches, i.e., matrix-matched and internal standard, as well as sensitive (LODs below 20 ng L⁻¹ for most of the target compounds in sewage and 30 ng g⁻¹ in sludge), versatile and green. The method was successfully applied to real samples from a novel pilot scale anoxic-aerobic photobioreactor, where the influence of the organic load on the removal efficiencies (REs) of the CECs was evaluated. The three operational stages, at three different concentrations of chemical oxygen demand (COD) (669±6 mg L⁻¹, 493±11 mg L⁻¹ and 434±11 mg L⁻¹), were maintained for 40 d (4× times the SRT) to achieve representative steady states. The maximum REs of ibuprofen, naproxen, salicylic acid, triclosan and propylparaben were 91±1%, 28±7%, 83±5%, 85±0% and 85±15%, respectively. COD concentration only affected clearly ibuprofen and naproxen REs. This pointed out oxidation as an important removal mechanism for these compounds. In contrast, salicylic acid and triclosan REs slightly increased at lower COD loads. For the propylparabens, high elimination rates (above 80%) were observed regardless of the COD concentration. Oxidation, biodegradation, sorption, volatilization and photodegradation were discussed as the possible removal mechanisms of the tested contaminants. This constituted the first evaluation of CECs removal by a synergistic interaction between algae and bacteria depending on the organic carbon load.

81 Abatement of amoxicillin, ampicillin and chloramphenicol from aqueous solutions using activated carbons prepared from grape slurry

R. Chitongu, Cape Peninsula University of Technology Cape Town South Africa / Chemistry; B. Obeddu, Cape Peninsula University of Technology / Faculty of Applied Sciences; G.S. Olatunji, Cape Peninsula University of Technology / Chemistry

There has been an increase in the use of pharmaceutical compounds for promotion of human and animal health, and the prevention of diseases over the past few decades. The sources of water and environmental contamination from these compounds include effluent discharges from household and several industrial activities. The capabili-second-stage sewage treatment in the treatment of pharmaceuticals from wastewaters in African countries is also not fully known. There is scarcity of information concerning the utilization of grape slurry waste as a precursor of carbon based adsorbents, as well as its application for the removal of amoxicillin (AMX), ampicillin (AMP) or chloramphenicol (CHL). This study therefore aimed at monitoring of the three antibiotic residues in selected surface water samples. Activated carbons were prepared from grape slurry waste by pyrolysis and evaluated for abatement of the antibiotics’ residues from aqueous solutions. An UHPLC-UV-DAD was optimized for the separation, detection and quantification of antibiotics in aqueous matrix. Solid Phase Extraction (SPE) procedure was optimized for recovery studies. Surface water samples were collected along the mainstream through nutrient and sludge sampling points over two seasons. The removal of antibiotics from aqueous solutions using activated carbons produced from grape slurry was also studied. Activated carbons were characterized using FTIR, SEM and EDX in order to understand the removal mechanisms of the contaminants by activated carbons. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediate these pollutants using particle filters and ozonation techniques. Results showed a notable abatement of the antibiotics onto activated carbons used. Thermodynamic evaluation showed that the sorption was exothermic, feasible but non-spontaneous with increased in temperature.

82 Biodegradation of organic micropollutants in constructed wetlands: comparison of design and operational parameters

P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; Y. Zhang, Southern University of Science and Technology / School of Environmental Science and Engineering; L. Tao, Nottingham Trent University / School of Animal, Rural and Environmental Sciences; L. Zhang, C.A. Arias, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science; H. Brix, Aarhus University / Department of Bioscience

Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove these contaminants. Therefore, the need for advanced treatment systems has been growing in order to be able to degrade some of these emerging contaminants, namely organic micropollutants. But the processes at the core of the removal of these compounds in CWs are yet unknown. Research being developed at Aarhus University aims at understanding the removal processes and fate of organic micropollutants in different types of CW systems. Five different experiments have been conducted in biofilm microbial community function. The plants Typha latifolia and Phragmites australis were the most efficient plant species in removing ibuprofen and iboxhol. Phragmites was the most efficient species to remove the pesticides tebuconazole and imazalil. Uptake, translocation and degradation of chiral pesticides inside the
Effects of PAH exposure on fuelling ability in a long distance migratory shorebird
K. Bianchini, University of Saskatchewan - Toxicology Centre / Toxicology; C.A. Morrissey, University of Saskatchewan / Biology

Many shorebirds are long distance migrants that stop to refuel along the journey where they can be exposed to pollutants that may impede fuelling for migration. Exposure to organic pollutants can cause potential effects on migration success, speed and subsequent population parameters since pre-migratory fuelling is correlated with reproductive performance upon reaching the northern breeding grounds. The polycyclic aromatic hydrocarbons (PAHs) found in marine oil pollution have the potential to interfere with pre-migratory fuelling physiology in shorebirds. However, a link between PAH exposure and pre-migratory fuelling has yet to be established. Our objective was to determine if PAHs or associated contaminants can affect condition and fuelling rates in a captive shorebird, the Sanderling and in the field at major shorebird stopovers. In this study, a captive population of 49 Sanderling (Calidris alba) was orally dosed with a commercial PAH mixture for 21 days at ecologically relevant concentrations (0, 12.6, 126, and 1260 µg/g d.w.). We found that PAH exposure and pre-migratory fuelling activity were significantly elevated in the high dose group relative to controls and fuelling rates and condition were also lower in dosed birds. Higher PAH exposures were associated with reduced serum bile acid concentrations, elevated serum creatine kinase concentrations, and with high serum lipase concentrations (in females). These results suggest that PAH exposure can interfere with lipid transport and metabolism and can cause muscle damage leading to poorer condition. We also captured Sanderling from the Gulf of Mexico, which is subject to recurring oil spills and from Chaplin Lake, Saskatchewan, a relatively uncontaminated site. We measured each bird’s body condition, fuelling status, and plasma PAH levels and attached miniature radio transmitters to a subset of birds (n=75). Motus radio telemetry array technology was used to determine the arrival and departure timing and stopover duration. We found that mean stopover durations in the Gulf of Mexico were longer than in Chaplin Lake (27 versus 15 days), and that stopover duration was associated with body condition and fuelling status at capture. We also measured higher plasma PAH concentrations in birds at certain Gulf sites, suggesting that PAH exposure is associated with lower pre-migratory fuelling rates. This work will inform shorebird conservation by providing valuable insight into a potential cause of migratory shorebird declines.

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Persistent organochlorine (OC) pesticides, including p,p'-DDT, have been detected in many regions of the world for more than 30 years, but are still present in the top predators of terrestrial and aquatic food webs. The Canary Island were one of the Spanish regions with the highest use of OC pesticides due to the intensity of its agriculture. A previous study performed between January 2009 and August 2010 in 30 unhatched eggs of West Canary common kestrel (Falco tinnunculus canariensis) from Tenerife Island showed elevated concentrations of p,p'-DDE (17.9 µg/g dw; equivalent to 4.9 µg/g ww). Here, we have monitored the levels of OC compounds (pesticides and polychlorinated biphenyls) in 40 unhatched eggs of West Canary common kestrel from Tenerife Island collected between 2009 and 2016. We have also performed the peroxidation of the porphyrins (1,1′-diiodo-4,4′-biphenyl) and quantified their transformation products in bird eggshells. The obtained data correlated with reproductive performance upon starting from a fluorochemical plant in Antwerp, where they can be exposed to pollutants that may impede fuelling for migration. Exposure to organic pollutants can cause potential effects on migration success, speed and subsequent population parameters since pre-migratory fuelling is correlated with reproductive performance upon reaching the northern breeding grounds. The polycyclic aromatic hydrocarbons (PAHs) found in marine oil pollution have the potential to interfere with pre-migratory fuelling physiology in shorebirds. However, a link between PAH exposure and pre-migratory fuelling has yet to be established. Our objective was to determine if PAHs or associated contaminants can affect condition and fuelling rates in a captive shorebird, the Sanderling and in the field at major shorebird stopovers. In this study, a captive population of 49 Sanderling (Calidris alba) was orally dosed with a commercial PAH mixture for 21 days at ecologically relevant concentrations (0, 12.6, 126, and 1260 µg/g d.w.). We found that PAH exposure and pre-migratory fuelling activity were significantly elevated in the high dose group relative to controls and fuelling rates and condition were also lower in dosed birds. Higher PAH exposures were associated with reduced serum bile acid concentrations, elevated serum creatine kinase concentrations, and with high serum lipase concentrations (in females). These results suggest that PAH exposure can interfere with lipid transport and metabolism and can cause muscle damage leading to poorer condition. We also captured Sanderling from the Gulf of Mexico, which is subject to recurring oil spills and from Chaplin Lake, Saskatchewan, a relatively uncontaminated site. We measured each bird’s body condition, fuelling status, and plasma PAH levels and attached miniature radio transmitters to a subset of birds (n=75). Motus radio telemetry array technology was used to determine the arrival and departure timing and stopover duration. We found that mean stopover durations in the Gulf of Mexico were longer than in Chaplin Lake (27 versus 15 days), and that stopover duration was associated with body condition and fuelling status at capture. We also measured higher plasma PAH concentrations in birds at certain Gulf sites, suggesting that PAH exposure is associated with lower pre-migratory fuelling rates. This work will inform shorebird conservation by providing valuable insight into a potential cause of migratory shorebird declines.
analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; µg/g dw): p,p’-DDE, 15.2 ± 1.7; p,p’-DDT, 0.118 ± 0.020; PCBs, 0.459 ± 0.121; HCHs (hexachlorocyclohexane isomers), 0.021 ± 0.003; and HCB (hexachlorobenzene), 0.0042 ± 0.0004. p,p’-DDE levels have remained elevated for more than 20 years and these levels were statistically associated in generalized linear models with the surface of active and abandoned cropland in a 200 m-radio around the nest (+), distance from nest to urban areas and greenhouses (-, altitude (+) and year (highest in 2011). PCB levels were associated with distance from nest to roads (-) and altitude (+). The shell index was not affected by p,p’-DDE levels, but decreased with embryo development. Protoporphyrin IX was the only pigment in eggshells and its content was negatively affected by HCB levels in egg content.

87 Long-term increase in secondary exposure to anticoagulant rodenticides in European polecats in Britain
K.A. Samsbury, University of Exeter / Environment and Sustainability Institute; R. Shove, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Croose, The Vincent Wildlife Trust; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hankte, National Museums Scotland; R. McDonald, University of Exeter / Environment and Sustainability Institute
As a result of legal protection and population recovery in Great Britain, European polecats (Mustela putorius) are expanding into areas associated with greater usage of second-generation anticoagulant rodenticides (SGARs). We analysed livers from polecats found dead (mostly road casualties) from 2013-2016 for residues of five SGARs. We related variation in residues to polecat traits (age, sex, provenance), to potential exposure pathways by analysing stable isotopes of carbon (δ13C) and nitrogen (δ15N) in whiskers, and to data collected from polecats in the period 1992-99. In all, 54 of 68 (79%) polecats from 2013-16 had detectable liver residues of at least one SGAR. Bromadiolone (71%) was the most commonly detected compound, followed by difenacoum (53%) and brodifacoum (35%). Liver SGAR residues did not vary with sex or with the season in which the polecat died. We found a positive association between occurrence of liver SGAR residues and δ15N values. Polecats in Britain feed predominantly on rats and rabbits and our findings are consistent with the concept that individuals feeding on rats (higher trophic level than rabbits) are more likely to be exposed to SGARs. Total SGAR liver concentrations were higher in polecats from arable than pastoral habitats, consistent with more intensive SGAR use on arable farms, and higher in western than eastern regions although the reason for this is unclear. Both number of compounds and total SGAR concentrations were positively associated with age, presumably due to multiple sub-lethal exposures during an animal’s lifetime; older animals may thus be at most risk from poisoning due to progressive accumulation of liver residues.

88 Poster spotlight: MO035, MO036, MO083
Environmental risk assessment in time and space - new approaches to deal with ecological complexity
P. Thorbek, Syngenta / Environmental Safety; N. Galic, Syngenta / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior
Landscape processes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the delivery of sub-lethal exposures during an animal’s lifetime; older animals may thus be at most risk from poisoning due to progressive accumulation of liver residues. When we compared data for polecats from 2013-16 with those for polecats that died in 1992-99 and accounted for differences between studies in detection limits, we found that the rate of detection of SGARs in polecats in Britain increased 1.7 fold over the 25 year period. This increase was not restricted to newly re-colonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

89 The threshold option, the recovery option and landscape modelling
P. Thorbek, Syngenta / Environmental Safety; M. Wang, WSC Scientific GmbH / Dept E fate; Modelling; M. Foudoulakis, Dow Agrosciences / RSRA ERS
For many compounds the intrinsic toxicity as determined in toxicity studies does not reflect toxicity and risk adequately. Rather other mechanisms determine which species are most at risk (local species) and how large the risk posed to these species is. These include for example elimination rates and feeding behaviour, which are not considered in the first tier. In the present presentation results from two case-studies are given which demonstrate how uncertainty in the risk assessment can be reduced by trying to understand mechanisms that lead to toxicity and mechanism determining the actual and long-term risk of mammals and birds in the field. Field data help to verify the obtained knowledge and to determine an empirical margin of safety. Finally, population modelling is used to answer what-if questions in order to answer questions on the relevance of effects when considering specific worst-case assumptions. In both example compounds metabolism and excretion together with feeding behaviour mainly determined the acute and long-term risk. All of these mechanisms are not considered in the first tier risk assessment and without these it would not be possible to understand the risk of the compounds shown here. This understanding significantly reduced the uncertainty of the risk assessment, because with the gained knowledge it is possible to identify critical scenarios.

90 Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms
E. Zielińska, Jagiellonian University / Institute of Environmental Sciences; C.J. Topping, Aarhus University / Department of Bioscience; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group
Species richness and population sizes in agro-ecosystems have decreased dramatically during the last decades. The current scheme of agricultural intensification resulting in landscape simplification is considered one of the main causes of this biodiversity loss, along with widespread use of pesticides. As the management of landscape heterogeneity seems to be crucial for maintaining vital populations in agro-systems, it is necessary to include the landscape component in ERA and as the important mitigation strategy. We present a methodological framework for modelling the spatio-temporal heterogeneity in agricultural landscapes. The framework has been implemented within the ALMaSS simulation system allowing to investigate the effects of changes in landscape structure and management on the population size and distribution of animals. We describe spatial landscape heterogeneity through a detailed land cover map, in which farmed areas are represented as accurate maps of fields grouped into farm units of different types (e.g. arable, pasture) and species. Landscape heterogeneity refers to both crop management throughout a year, described through individually tailored management plans for each crop, and the cropping system understood as a pluriannual crop rotation. Crop management plans consist of combinations of farm activities (including pesticide treatments), as well as time windows and probabilities of carrying out activities. The temporal component also includes weather conditions and vegetation growth models for all vegetation types and crops. Such approach gives a highly realistic, updated on a daily basis, dynamic landscape with vegetation growing in response to the weather, and the pattern of farming activities related to each specific crop, farm, and field. Our methodological framework, supported with semi-automated procedures for spatial data management, makes creation of highly realistic representations of agricultural landscapes feasible and usable for landscape-scale risk assessment. More importantly, the presented tools allow for testing in silico various scenarios of agricultural practices, including pesticide use, in differently structured landscapes. This seems at the moment the most promising strategy for elaborating sustainable agricultural practices that would allow for high productivity, whilst still protecting the agrobiodiversity. This study was supported by the National Science Centre, Poland (2015/19/B/NSZ/01939).

92 Where are the Springtails? A vertical distribution model for Colembolans
V. Roeber, RWTH Aachen University / Institute for Environmental Research / Institute for Environmental Research BioV; L.S. Tschopke, RWTH Aachen University / Institute for Environmental Research BioV; T. Preuss, Bayer Ag / Environmental Safety; A. Schafer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Ross-Nickoll, RWTH Aachen
A practical application of an individual-based stickleback model in the ERA of PPPs
K. Mintram, University of Exeter / Biosciences; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; S. Maynard, AstraZeneca / Safety Health and the Environment; A. Brown, Exeter University / Biosciences; C. Liu, Syngenta / Syngenta Environmental Safety; S. Parker, Cefas Weymouth Laboratory; P. Thobek, Syngenta / Environmental Safety
Population models are employed in the environmental risk assessment (ERA) of chemicals, including plant protection products (PPPs), to extrapolate from individual-level effects to predictions of effects on whole populations. Individual-based models (IBMs) allow for the incorporation of individual variability, population-level interactions, and specific behaviors. IBMs can therefore be used to extrapolate from a large number of individual-level endpoints and simulate potential effects on populations under realistic environmental conditions. We present an IBM of the three-spined stickleback (Gasterosteus aculeatus) developed for the purpose of predicting population-level effects for exposure to chemicals. The IBM was developed from a series of sub-models parameterised with empirical data obtained from the wild. Modelled population dynamics (e.g. size/age class distributions and annual fluctuations in population abundance) emerge from the adaptive traits, behaviours and interactions between individuals and their environment (including toxicant exposure). Here, we describe the development and validation of a stickleback IBM and demonstrate its practical application in ERA. Empirical data quantifying the reproductive effects and subsequent recovery, following exposure to a fungicide, were input into the IBM as a sub-model. Various exposure and recovery scenarios were simulated to predict population-level effects over time. The modelled outputs demonstrated that exposure duration and individual recovery post-exposure can influence the overall effects of chemical exposure on population abundance. We suggest that using IBMs to incorporate realistic exposure and recovery scenarios may improve current ERA and result in more realistic protection standards for wild populations.

Using the Bayesian network relative risk model to integrate molecular effects, ecological context and ecosystem services to estimate risk over space and time
M. Baccaro, Wageningen University / Toxicology Department; H.H. van den Berg, Wageningen University / Toxicology Department; D. Hermans, L. Loot, Wageningen University and Research; N. van den Brink, Wageningen University / Dept of Toxicology
Ag2S-NP is the main product of transformation of Ag-NP in the waste water treatment plant (WWTP). In many European countries, sewage sludge containing Ag2S-NPs is applied on the surface of the soils as soil amendments. Earthworms are important ecological engineers in the soil ecosystem, which, on one hand, may be affected by Ag released from the amendments and, on the other hand, may influence the distribution of metals. Therefore, the aim of this study was to determine effects of Ag2S-NP application on an important earthworm driven process, i.e. bioturbation and the effect of the earthworm activity on the vertical distribution of Ag2S-NP in the top soil. Their interplay was assessed in two experiments, in presence or absence of artificial rain fall. Around 2 cm of soil treated with 10 mg Ag kg-1 dry weight soil of Ag2S-NP (28.0±0.4 nm) was applied on top of natural soil columns (10 cm) mimicking an application of 200 Mg sludge ha-1 dry weight. For the first experiment, columns were prepared with and without Lumbricus rubellus and with and without Ag2S-NPs. Every week for 28 days earthworms and four different layers of the soil columns (0-2, 2-4, 4-6, 6-10, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily application of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by pICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms over time. Ag reached the bottom layer of the columns where worms were present while no Ag was found at the bottom layer of the column without worms. This indicates that earthworms do not avoid the contaminated top layer. Ag content in earthworms was relatively constant overtime with an average value of 1.06±0.32 mg Ag kg-1 dry weight. The first study shows that uptake of Ag2S-NPs in earthworms occurred regardless of the partial exposure and points towards the crucial role of earthworm bioturbation in the mobilisation of metal nanoparticles in the top soil. The second experiment of the study is currently being performed, results will be presented at the meeting.

Short- and long-term approaches to determine the fate of silver nanoparticles in freshwater systems

The environment as a reactor determining fate and toxicity of nanomaterials (II)
95 Mobilisation of silver sulphide nanoparticles in soil column by earthworms’ bioturbation
M. Baccaro, Wageningen University / Toxicology Department; H.H. van den Berg, Wageningen University / Toxicology Department; D. Hermans, L. Loot, Wageningen University and Research; N. van den Brink, Wageningen University / Dept of Toxicology
Ag2S-NP is the main product of transformation of Ag-NP in the waste water treatment plant (WWTP). In many European countries, sewage sludge containing Ag2S-NPs is applied on the surface of the soils as soil amendments. Earthworms are important ecological engineers in the soil ecosystem, which, on one hand, may be affected by Ag released from the amendments and, on the other hand, may influence the distribution of metals. Therefore, the aim of this study was to determine effects of Ag2S-NP application on an important earthworm driven process, i.e. bioturbation and the effect of the earthworm activity on the vertical distribution of Ag2S-NP in the top soil. Their interplay was assessed in two experiments, in presence or absence of artificial rain fall. Around 2 cm of soil treated with 10 mg Ag kg-1 dry weight soil of Ag2S-NP (28.0±0.4 nm) was applied on top of natural soil columns (10 cm) mimicking an application of 200 Mg sludge ha-1 dry weight. For the first experiment, columns were prepared with and without Lumbricus rubellus and with and without Ag2S-NPs. Every week for 28 days earthworms and four different layers of the soil columns (0-2, 2-4, 4-6, 6-10, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily application of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by pICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms over time. Ag reached the bottom layer of the columns where worms were present while no Ag was found at the bottom layer of the column without worms. This indicates that earthworms do not avoid the contaminated top layer. Ag content in earthworms was relatively constant overtime with an average value of 1.06±0.32 mg Ag kg-1 dry weight. The first study shows that uptake of Ag2S-NPs in earthworms occurred regardless of the partial exposure and points towards the crucial role of earthworm bioturbation in the mobilisation of metal nanoparticles in the top soil. The second experiment of the study is currently being performed, results will be presented at the meeting.
Engineered silver nanoparticles (Ag ENP) are present in many consumer products. Hence, the ENP enter into sewers and wastewater treatment plants with a high predicted removal into the sludge. If the sludge is applied to agricultural soils, decomposition might result in resuspension of the ENP. The fate and impact of Ag ENP in soils is still unclear. Short- and long-term column remobilization experiments with disturbed soils, short-term column percolation experiments with undisturbed soils, and long-term field lysimeter experiments were conducted. All experiments were performed with sterically stabilized Ag ENP (AgNM-300k), and a slightly loamy Cambisol (ReSoel 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag\textsubscript{dosed}) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol incubation experiment showed the highest remobilization of Ag which was below 6% of the Ag\textsubscript{dosed} concentrations in the soil columns. The correlation between remobilized Ag\textsubscript{dosed} and Ag\textsubscript{dosed} concentrations suggests that the remobilized amount of Ag was associated to soil colloids. The breakthrough of Ag ENP in the column percolation experiments was high but incomplete in the Cambisol and the Luvisol.

Particularly, columns with preferential flow pathways showed low Ag ENP retardation. In the unsaturated experiments, a nearly complete retention was found for the Luvisol that showed a clearly smaller pore size structure than the Cambisol. The horizontal displacement of Ag\textsubscript{dosed} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag\textsubscript{dosed} release to the percolate water (t=480 d, control=24 ng l\textsuperscript{-1}, Lysimeter (7 mg kg\textsuperscript{-1})=56 ng l\textsuperscript{-1}, DIN 38402-11) was obtained for the lysimeter with the highest Ag ENP application. TNP waters induced a reaeration attributable to the high flow rate, concentrations detected in the lysimeter with the lower Ag ENP concentration. All roots (wheat, canola, barley) showed a low uptake of Ag\textsubscript{dosed}. All approaches showed a more or less high retention of Ag ENP in soils why soils are a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil microecosystem and the root uptake (e.g. beet) needs further long-term investigations.

97 Determination of attachment efficiency (α) for ENPs in different types of soils by saturated column experiments

K. Nörrforss, SLU Uppsala / Soil and environment; G. Cornelis, Swedish University of Agricultural Sciences / Soil and environment

The attachment efficiency (α) has been suggested as the most appropriate fate descriptor for transport of engineered nanoparticles (ENPs) in soils and saturated column experiments as the most accurate method to obtain α. Due to the complexity of the soil composition and texture, a small change in porewater composition of the column protocol may affect the resulting attachment efficiency obtained from the results. The aim of this work is to study the effect of soil composition, flow velocity, initial ENP concentration and the size of ENPs on the calculated attachment efficiency for the specific ENP-soil systems. The α values for nominally 20 and 80 nm citrate coated gold ENPs (Au ENPs), as well as 30 nm sulphonat gold ENPs (Ag\textsubscript{S} ENPs) were induced in a readjusted packed column expiring this in different soils sampled in the UK. Artificial rainwater was used as the eluent. 10 mM NaNO\textsubscript{3} was used as a conservative tracer to estimate the effective porosity and dispersivity. All columns were packed with an excess of rainwater to limit the amount of air present in the saturated soil. α was either calculated from breakthrough curves of Au/Ag or from the irreversible attachment rate modelled using Hydrus 1D or the relative recovery of the ENPs in the break through curves. Preliminary results show no significant differences in α values for 80 nm and 20 nm Au ENPs. However, the Au ENP breakthrough curves appeared dependent on the flow rate. Even though the shape of the break through curves changes with flow rate, this can be compensated during modeling arriving at consistent α values between the systems with varying flow rates. Furthermore, presence of air in the column affects the distribution of ENPs in the packed columns. Finally, an increase in initial ENP concentration give higher α values and cannot be accounted for in the equations used for estimating the attachment efficiency. In conclusion, when varying the initial ENPs concentration into the columns, the α value is significantly affected. Hence, low NP concentrations need to be used in the column experiments to maintain an appropriate accuracy of calculated α values. Moreover, inclusion of air in the systems appears to induce artefacts that complicate determination of α for specific NP-soil combinations.

98 The transformation of copper and zinc (-nanoparticles) during sewage sludge composting

J.J. Wielinski, ETH Zürich/Eawag / Process Engineering; A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering; P. Gagnaire, Eawag / Process Engineering; R. Kaege, Eawag - Swiss federal Institute of Aquatic Science and Technology / Process Engineering; M. Morgenroth, Eawag - Swiss federal Institute of Aquatic Science and Technology / Process Engineering; T. Hofmann, University of Vienna / Department of Environmental Geosciences

Engineered nanoparticles in wastewater streams are effectively retained by wastewater treatment plants and accumulate in sewage sludge. Digested sludge is subsequently combusted for further volume reduction to allow for phosphorous recovery at a later stage. This study focuses on two metals Cu and Zn, as both are present in digested sludge but are also used as nanomaterials. We investigated (i) the transformation of ZnO and CuO-NP during anaerobic digestion, (ii) the subsequent transformation of Cu and Zn during sewage sludge combustion, and (iii) whether the form of Cu and Zn affects the fate during anaerobic digestion and combustion. We spiked CuO-NP, ZnO-NP, Cu\textsuperscript{2+} and Zn\textsuperscript{2+} to four aliquots of sewage sludge representing four distinct conditions for 24h. One aliquot was kept as control. Thereafter, sludge was combusted in a pilot fluidized bed reactor and ashes were collected. Sludge and ashes were prepared for Cu - and Zn K-edge X-ray absorption spectroscopy (XAS) measurements. The speciation of the metals was obtained through linear combination fitting (LCF) of X-ray absorption near edges spectra (XANES) and extended X-ray absorption fine structure (EXAFS) data. LCF fits of experimental XANES and EXAFS data suggest a high degree of sulfidation of both Cu and Zn during anaerobic digestion, irrespective of the spiked form of Cu and Zn. For control sludge and sludge spiked with Zn\textsuperscript{2+}, LCF results from EXAFS data suggest that ~90% of the Zn was present as sulphides, the remaining fraction was best described by a ZnO reference spectrum. For sludge spiked with ZnO-NP, a lower degree of sulfidation (~83% ZnS) with a concomitantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a Zn spectrum that was co-precipitated with Ferrihydrite. All LCF fits of Cu in the digested sludge indicated complete sulfidation of Cu. After combustion, LCF fits of the experimental EXAFS spectra revealed the presence of ~30% Chalcopyrite, indicating that Cu was not completely oxidised during the combustion. Comparable experiments with Cu\textsuperscript{2+} and CuO were returned from LCF analyses. All Cu spectra of the sludge and the ashes were both comparable and independent of the added form of Cu. For Zn, however, the addition of ZnO-NP resulted in a slightly lower degree of sulfidation compared to the control sludge and to the sludge that was spiked with dissolved Zn\textsuperscript{2+}. All Zn spectra of the ashes were comparable.

99 Soil ecotoxicity and dissolution of a marketed nanosilver product - a direct comparison with ionic silver

J. Mertens, Precious Metals and Rhenium Consortium c/o EMPF; J. Arijs, ARCHE; E. Smolders, Katholieke Universiteit Leuven; D. Leverett, wca; K. Oorts, ARCHE

As part of the REACH Substance Evaluation for silver, new data was generated to further justify read-across from ionic silver to silver nanoforms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanof orm with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~83% ZNHS) with a concomitantly high fraction of ZnO (17%)) was tested as source of ionic silver. Soil nitrification was tested according to the internationally standardised and accepted assay for testing toxicity to soil microorganisms (OECD Test Guideline No. 216). Three soils were selected falling within the P10-P90 interval of European agricultural soils for pH, organic carbon content and cation exchange capacity. Total silver in soil, and total dissolved (0.45 µm membrane filtered) and 'truly' dissolved silver (1 kDa centrifuge filtered) in porewater were measured (ICP-MS). Toxicity of nanosilver on soil nitrification was similar to or less than silver nitrate when expressed on the basis of total Ag in soil. Total and truly dissolved Ag in porewater decreased over time after silver nitrate spiking, suggesting ageing processes. Concentrations were always higher or equal to corresponding values after nanosilver spiking. For nanosilver spiking, total and truly dissolved Ag in porewater initially increased, and decreasing dissolution processes. From day 4-7 after spiking onwards, concentrations decreased over time suggesting that ageing becomes more important than dissolution. Truly dissolved Ag in porewater qualitatively explained observed toxicity of silver nitrate compared to nanosilver. The data show that soil ecotoxicity data for ionic silver are conservative for soil ecotoxicity of nanosilver.

100 Tackling nanoparticle fate assessment in surface waters - heteroaggregation as a key process

H. Walsh, University of Vienna, Dep. of Environmental Geosciences / Environmental Geosciences; R. Tackli, ETH Zürich/Eawag / Process Engineering; F. yvonne, Eawag, Swiss Federal Institute of Aquatic Science and Technology; T. Hofmann, University of Vienna / Department of Environmental Geosciences

The increasing use of engineered nanoparticles (ENPs) inevitably entails emissions to the environment, raising calls for nano-specific environmental risk assessment approaches and regulations. As surface waters are the major receiving compartment, assessing risks requires understanding the aquatic fate of ENPs within the aquatic food web. Unless soluble, inorganic aggregations, including homo- and heteroaggregation with natural suspended particulate matter (SPM), or stabilisation by natural organic matter (NOM). Due to the omnipresence and larger size of SPM, heteroaggregation is much more likely than homoaggregation. However, integration of this process into fate models and exposure assessment requires parametrisation and is still limited by the lack of simple, yet environmentally relevant experimental protocols. Such could be developed along the lines of the recently adopted OECD testing guideline 318 on ENP dispersion stability, currently accounting only for homoaggregation. The principles of homo- and heteroaggregation are basically the same: the probability of particle attachment is
controlled by the intrinsic particle properties and modified by the hydrochemical conditions (pH, electrolytes, NOM). Distinct from heteroaggregation is the complexity added to the system by SPM in the case of heteroaggregation. In this contribution we therefore propose an approach to develop a heteroaggregation testing protocol based on the OECD TG 318, with a focus on tackling SPM analogue selection. The development of such a protocol requires (1) selecting SPM analogues and their chemical fingerprinting to represent relevant environmental characteristics, and simple enough for routine testing, (2) an easy-to-handle experimental setup to estimate a heteroaggregation parameter, and (3) an accurate experimental method to validate the latter. Point (1) requires informed simplifications based on a profound understanding of the system. Relevant hydrochemical testing conditions have been established for heteroaggregation in the OECD TG 318 and will also apply for heteroaggregation. However, suitable analogues for natural SPM still need to be selected. We therefore reviewed literature for typical compositions of riverine SPM and carried out screening tests aiming at the creation of complex analogues representing relevant characteristics. Comparisons with simple SPM analogues revealed distinct aggregation behaviour, indicating the importance of complex SPM analogues for heteroaggregation.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (II)

101 MC-252 biomarkers as indicators of oil exposure and pollutant concentration in sediments of the northern Gulf of Mexico
L.M. Basirico, Louisiana State University; R.J. Portier, Louisiana State University / Environmental Sciences

Different types of crude oil can be identified by the arrangement of constituents, or their chemical fingerprint. In addition, chemical fingerprinting can be used to associate contaminated sediments with specific spill events like the Deepwater Horizon disaster of 2010. Mississippi Canyon-252 (MC-252) source oil, the type of crude oil specific to the Deepwater Horizon event, has been fully characterized by researchers at LSU, including pattern identification of the ion 217 and 218 hopane/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shooing regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the study area. The main effects-model used in the present study. The lack of MC-252 biomarkers in the vast majority of the sampled sediments, indicated that the PAH contamination in the current study was not from the Deepwater Horizon oil spill event. There is need for better markers of the origination of PAHs in freshwater and marine sediments. Furthermore, crude oil is not the only or even the best indicator of potential toxicity of these sediments.

102 Downregulation of hsp90 expression and increased intermoul duration in the blue crab, Callinectes sapidus, in response to oil exposure
S. Chiasson, Loyola University / EEB; S.M. Giltz, C.M. Taylor, Tulane University / Ecology & Evolutionary Biology

The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 780 million liters of crude oil spilling into Gulf waters. In an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. In response to this event, researchers at LSU, including pattern identification of the ion 217 and 218 hopane/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shooing regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the study area. The main effects-model used in the present study. The lack of MC-252 biomarkers in the vast majority of the sampled sediments, indicated that the PAH contamination in the current study was not from the Deepwater Horizon oil spill event. There is need for better markers of the origination of PAHs in freshwater and marine sediments. Furthermore, crude oil is not the only or even the best indicator of potential toxicity of these sediments.

103 Physiological and molecular impacts of crude oil and/or dispersant-contaminated seawater and sediments on the sponge Halichondria panicea (phyllum Porifera).
J. Vlag, Heriot-Watt University / School of Energy, Geosciences, Infrastructure and Society; J.M. Roberts, The University of Edinburgh / Grant Institute; T.B. Henry, Heriot-Watt University / The School of Energy, Geosciences, Infrastructure and Society

Sponges (phyllum Porifera) are a diverse group of filter-feeder organisms present in most aquatic environments. In the marine environment, sponges perform a wide range of ecological functions including cycling of nutrients such as carbon, nitrogen and silica; and, in areas where they are present at high densities (spoon grounds), they provide a habitat for a diverse range of benthic organisms. Because of their importance within marine ecosystems, the impacts of anthropogenic activities such as hydrocarbon exploration and production on marine sponges must be assessed. The objectives of this study were to: (1) determine the physiological impact of crude oil and/or dispersant contaminated seawater and sediments in model sponge Halichondria panicea; and (2) characterise the effects of crude oil and/or dispersant contaminated seawater exposure on the transcriptome of H. panicea. A series of 48-hydrocarbon contaminated sediments (0.25% crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shooing regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the study area. The main effects-model used in the present study. The lack of MC-252 biomarkers in the vast majority of the sampled sediments, indicated that the PAH contamination in the current study was not from the Deepwater Horizon oil spill event. There is need for better markers of the origination of PAHs in freshwater and marine sediments. Furthermore, crude oil is not the only or even the best indicator of potential toxicity of these sediments.

104 Advances in the effects of UV on oil toxicity in aquatic organisms
A.P. Roberts, K. Bridge, University of North Texas / Advanced Environmental Research Institute; J. Morris, Abt Associates; B.J. Venables, University of North Texas / Advanced Environmental Research Institute; M.O. Krasne, Abt Associates; M.L. Gielazyn, NOAA / co USEPA Region IV

Polycyclic aromatic hydrocarbons (PAHs) are a class of organic contaminants that are a common component of oil spill sediments. PAHs are ubiquitous in the environment, with many being persistent in the environment for very long periods of time. In addition, PAHs can be photochemically transformed into more toxic forms, such as PAH photoinduced toxicants, which can be released into the environment. These photoinduced toxicants can cause a variety of adverse effects on aquatic organisms, including growth inhibition, decreased reproduction, and increased mortality. In this study, we investigated the effects of UV radiation on the toxicity of PAHs to aquatic organisms. Specifically, we examined the effects of UV radiation on the toxicity of PAHs to red drum (Sciaenops ocellutus) and zooplankton (Daphnia magna) that were exposed to a single PAH (fluoranthene) or a complex PAH mixture prepared from weathered crude oil with varying PAH and UV exposure scenarios. Red drum tests were conducted as a single pulse exposure, and daphnia tests were conducted as static renewals. Toxicity (LC50) was measured after exposure to the PAH mixture. The results of this study indicate that the LC50 of PAHs was significantly lower in the presence of UV radiation compared to the absence of UV radiation. Additionally, the LC50 of PAHs was significantly lower in the presence of UV radiation compared to the absence of UV radiation. These results suggest that UV radiation can significantly increase the toxicity of PAHs to aquatic organisms, and that UV radiation should be considered in future studies of PAH toxicity.
M.G. Barron, U.S. EPA / Gulf Ecology Division

Photoenhanced toxicity is a distinct mechanism of petroleum toxicity that is mediated by the interaction of solar radiation with specific polycyclic aromatic compounds (PACs) in oil. Phototoxicity is observed as a 2 to greater than 1000-fold increase in chemical toxicity to aquatic organisms that have also been exposed to light sources containing sufficient quantity and quality of ultraviolet radiation (UV). Surprisingly, UV light is not only detrimental to the surface and weathered middle distillates, crude and heavy oils can exhibit photoenhanced toxicity. These same products do not exhibit phototoxicity in standard test protocols because of low UV irradiance in laboratory lighting. Fresh water, estuarine and marine waters have been shown to have sufficient solar radiation exposure to elicit photoenhanced toxicity, and a diversity of aquatic invertebrate and fish species can exhibit photoenhanced toxicity when exposed to combinations of oil and UV. Risks of photoenhanced toxicity will be greatest to early life stages of aquatic organisms that are translucent to UV and that inhabit the photic zone of the water column and intertidal areas exposed to oil.

106 Pilot microcosm study to assess the fate and toxicity of diluted bitumen in an outdoor aquatic environment.

J.M. Blais, University of Ottawa / Biology; M.L. Hanson, University of Manitoba / Environment and Geography; D. Ortzel, Queens University; B. Hollebone, Environment Canada / Emergencies Science & Technology; V. Palace, M. Paterson, ISD-Experimental Lakes Area; J. Rodriguez Gil, University of Ottawa / Department of Biology

Pipelines are the safest mode of transporting Canada’s oil to markets, but they are a concern for the public, especially the potential effects of diluted bitumen (dilbit) spills on the environment. We added diluted bitumen (dilbit) to two land-based microcosms (2 m diameter) containing water and sediment from a nearby lake at the ISD-Experimental Lakes Area in Northwestern Ontario for a span of 11 days, and compared our results to a control enclosure with no added dilbit. Microcosms were treated with 0 (Control), 0.15, or 1.5 liters of Cold Lake Winter Blend dilbit (CLB-W), representing dilutions of 1:10,000 and 1:1000 oil/water, v/v, which spans the range of historical dilbit spills to water. Samples of water, sediment, air and oil were collected through the study in order to determine the fate, weathering, and behaviour of the dilbit. Total petroleum hydrocarbons in the high treatment microcosm gradually increased from under 100 mg/L in the first 24 hours to over 1200 mg/L by day 11, with no evidence of reaching equilibrium over this duration. Although a decrease in total phytoplankton biomass was observed in all microcosms over the study, the biomass in the high microcosm was about one-half or less than that in the control microcosm for the first week. Thereafter, the rate of biomass loss in the dilbit-treated microcosms slowed down, which could indicate recovery of the primary producers as the oil slick sank to the sediments. This study is among the first to examine the behaviour of dilbit in an outdoor setting under natural conditions of sunlight, wind and rain, and provides a case study that will inform future dilbit studies in natural (outdoor) environmental settings.

Fish model species in human and environmental toxicology (II)

107 Life-stage, and species-specific effects of dietary methylmercury exposure K. Connon, University of North Carolina Wilmington / Advanced Environmental Research Institute; Y. Zhang, University of North Texas Health Science Center; T. Curran, J.T. Magnuson, University of North Texas / Biology; M. Allen, University of North Texas Health Science Center; B.J. Venables, A.P. Roberts, University of North Texas / Advanced Environmental Research Institute

Mercury is a globally distributed contaminant, found even in remote aquatic ecosystems. Once deposition occurs, it can be biologically transformed into organic forms, such as methylmercury (MeHg) [1]. MeHg is highly bioavailable, and it bioaccumulates and biomagnifies in biota leading to potentially toxic body burdens in long-lived organisms at high trophic levels. MeHg can be actively transferred from mother to offspring, through large amino acid transporters with the potential to cause severe, irreversible effects on developing organisms. Here, we describe the development loss in deuterium-exchanged maternally-transferred dietary MeHg in a model fish species (Pimephales promelas). Exposure to environmentally relevant concentrations of MeHg during development led to alterations in the dopaminergic system, metabolome, gene expression, behavior, hatch time, size, and embryo-larval survival. Similarly, effects on the dopaminergic system in specific regions of the adult P. promelas brain were observed after a 30-day dietary exposure. Recently, a functional link between gut microbiota and dopamine production in teleosts has been established. The bidirectional communication between the gut and the central nervous system (CNS) is referred to as the gut-brain axis, which plays an important role in behavior, brain function, neurodevelopment, and the progression of neurodegenerative disorders. Therefore, we characterized MeHg-mediated changes to the gut microbiome composition in P. promelas adults. Because the dopaminergic system is highly conserved among taxa, we sought to confirm the altered dopamine concentrations in P. promelas brain in a higher vertebrate species. Metabolomics was performed on the mid-brains of male mice (Mus musculus CD-1) exposed to similar concentrations of dietary MeHg for 30-days. Changes in dopamine concentrations of the telost brain were mirrored in the mid-brains of male mice, and several other significant changes to the mouse mid-brain metabolome were detected. Collectively, these results suggest current environmental exposure to MeHg are sufficient to induce a number of molecular-level changes that are associated with costs to whole organism fitness, with consequences for multiple life stages, and species. Due to the similar changes detected in mice, there is increasing evidence to suggest teleosts as a surrogate model species for studies assessing effects of MeHg on highly conserved systems in higher vertebrates.

108 Characterization of molecular toxicity pathways of Fluoxetine in rainbow trout and white sturgeon using RNA-Seq whole transcriptome analyses A. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; B.K. Eisner, University of Saskatchewan / Toxicology Centre; S. Tang, Chinese Center for Disease Control and Prevention; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

The increasing number of emerging chemical contaminants (ECC) and their unknown effects to aquatic ecosystems serves as an impetus to develop advanced environmental risk assessment (ERA) approaches to improve regulatory decision-making. This is because current ERA rely on live animal testing that are expensive, time consuming and of ethical concern. Furthermore, the use of model organisms does not assure protection towards native species because of the limited understanding of their physiological and trophic attributes. Hence, there is a need to establish an unbiased approach to characterize toxicity pathways that allow probing of an entire biological system without a priori knowledge of the mechanisms of toxicity. Advances in ‘omics technologies can improve current testing strategies as they offer high-throughput and cost-effective approaches to examine patterns of mechanistic toxicity which could guide endpoint selection and enable the identification of objective endpoints. Molecular toxicity pathway models to predict outcomes of regulatory relevance for the selective serotonine reuptake inhibitor, fluoxetine (FLX), in 2 fish species of concern in Canada. Juvenile rainbow trout (RBT) and white sturgeon (WS) were exposed to 125 µg/L FLX in 96h static-renewal system, and sequence-by-synthesis whole transcriptome analysis was used to determine unique differentially expressed in fish live and brains. A 0.05 cut-off false discovery rate identified differentially expressed contigs between FLX and control groups. A total of 406 and 429 contigs were significantly altered in RBT live and brains, respectively. Of these, 238(59%) and 236(55%) matched unique gene names. In WS, 252 and 192 contigs were significantly altered in live and brains, respectively, with 145(58%) matched unique gene names. Pathway analaysis using ontologies based on zebrafish in KEGG and GO Consortium showed a total of 101 affected pathways. Over half(58%) of the affected pathways were involved in biological processes while others were involved in cellular components (13%), molecular function (18%), and genetic information processing (11%). The result of this study will be compared to apical outcomes assessed in a parallel chronic study, and which will allow the assembly of toxicity pathways across multiple levels of organization with the end goal of identifying molecular markers that are indicative of adverse effects.

109 Transgenerational effects of early life stage exposure to endocrine disruptors across biological scales in a euryhaline model fish S.M. Brandner, Oregon State University / Environmental and Molecular Toxicology; B. DeCorten, J. Forbes, University of North Carolina Wilmington / Biology and Marine Biology; N.P. Burns, University of North Carolina Wilmington / Department of Biology and Marine Biology; H. Roark, Hunter Roark / Biology and Marine Biology; J.W. White, Oregon State University / Department of Fisheries and Wildlife; A.C. Mehinto, Southern California Coastal Water Research Project / Toxicology; M.L. Settles, University of California Davis / Genome Center; R.E. Connon, University of California, Davis / School of Veterinary Medicine

Emerging research demonstrates that EDCs, which agonize, antagonize, and / or synergize the effects of endogenous hormones, can cause deleterious effects in addition to their role as a result of early-life exposure as well as developmental and postnatal effects. A scarcity of studies exist of the model fish species, such as Menidia beryllina, a euryhaline fish with short generation time that is found throughout North America and is demonstrated to be sensitive to contaminants. As such, we exposed Menidia beryllina embryos (8 hpf) until 21 dph to different environmental combinations of EDCs and their effects. We exposed embryos to EE2 significantly skewed adult sex ratios (feminized) relative to controls. Findings from the F0 and
F1 generations demonstrate that exposure to EDCs increased growth in the parental larvae, and that androgenic treatment groups (Levo, TB) maintain this growth through the subsequent F1 generation. In the F0 adults, differences in immune response are apparent between bifenthrin and levonorgestrel, and this pattern is stronger in F1 adults, with significantly greater T-cell proliferation in bifenthrin-exposed individuals relative to controls. Bifenthrin-exposed parental females have increased atriotic follicles, and developmental defects are more pronounced in F1 embryos and larvae relative to parents. Future data gathered on gonadal histology, gene expression and DNA methylation will allow us to further hone in on the mechanisms causing higher order downstream effects. Elucidation of the mechanisms contributing to these higher order downstream effects will inform adverse outcome pathways, as well as allow for the quantification and comparison of responses to established and emerging endocrine disruptors across multiple biological scales.

110 Integrated OMICS imaging and imaging for a better understanding of ecotoxicological mechanisms - PAH developmental toxicity as an example

E. Vehmaenen, C. Rigaud, A.N. Eriksson, University of Jyväskylä / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; A. Rokka, S. Sarai, T. Suomi, Turku Centre for Biotechnology; A. Laiho, University of Turku and Abo Akademi University; J. Lihavainen, University of Helsinki; J. Haverinen, M. Vornanen, University of Eastern Finland; J.V. Kukkonen, University of Jyväskylä / Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; J.V. Kukkonen, University of Jyväskylä / Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; J.V. Kukkonen, University of Jyväskylä / Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; J.V. Kukkonen, University of Jyväskylä / Biological and Environmental Science;

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous contaminants in the environment. Many of them cause developmental defects in fish, and cardiovascular tissue seems to be the most sensitive tissue. The mechanisms of toxicity remain largely unresolved for many PAHs, though partial adverse outcome pathways (AOPs) exist for those that are aryl hydrocarbon receptor (AhR) agonists. Rainbow trout (Oncorhyncus mykiss) yolk sac larvae were exposed to sublethal concentrations of PAHs that act via different mechanisms of toxicity: Retene, an AhR agonist causing dioxin-like toxicity; pyrene and phenanthrene, weak AhR agonists causing toxicity independently of AhR; and fluoranthene, a CYP1A inhibitor interfering with PAH metabolism. Also the effects of a mixture of retene and fluoranthene were studied. Information was gained at multiple levels of biological organization to reveal the mechanisms of toxic action. Changes in cardiac transcriptome, proteome and metabolome were explored over time. Physiology and function of the heart were also studied. At the whole organism level, growth, yolk consumption, and developmental defects and abnormalities were monitored. Each PAH caused a unique pattern in OMICS analyses, and the mixture of retene and fluoranthene caused a different transcriptomic profile from that of each of the single compounds. Retene differentially regulated genes involved e.g. in muscle contraction and ion metabolism (ion channels). Retene and phenanthrene impaired cardiac function in larval rainbow trout. Both caused bradycardia, and phenanthrene caused arrhythmias. Phenanthrene affected cardiomycocyte electrical characteristics. As cardiovascular development is modulated by the beating heart and blood flow, alterations in cardiac function during development may have long-lasting impacts in cardiovascular tissues. Different PAHs clearly have different mechanisms of toxicity. The transcriptomic changes can at least partly account for the cardiotoxicity of retene, but the cardiotoxicity of phenanthrene seems to involve a direct effect on cardiac ion channels.

111 Physiological / Reproductive Status of Native Fish Exposed to a Complex Chemical Mixture in the BioBio River, Central Chile

M. Quiroz, M. Díaz, J.A. Gavilán, Universidad de Concepción / Biomarcadores; S. Casini, Universidad de Siena / Scienze Fisiche della Terra e dell’Ambiente; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; R.O. Barra, Universidad de concepción / Aquatic systems; J. Gavilán, Universidad de concepción / Celular Biology, Faculty of Biological Science

The BioBio River (Central Chile) is the third most important basin in Chile and is considered a Biodiversity Hot Spot with 17 native species. It presents a high degree of biodiversity and the use of water resources for various industrial, agricultural and urban activities, with many focal places of point and diffuse contamination along its main axis, in addition to a high degree of modification of land use associated with the basin. The high degree of intervention and fragmentation of this river has affected the biota and water quality mainly in its lower third, due to the convergence of complex chemical mixture and anthropic interventions in the main course. The objective of this study is to determine how the development associated with this river impacts the physiological/reproductive state of the native species Percilia irwinii (n = 66) in situ. Different sublethal responses were evaluated through biomarkers at different levels of biological organization (Biochemical, cellular, and individual) and environmental parameters (pH, temperature, conductivity and total dissolved solids). The results obtained indicate an increase in the Hepatic EROD activity (ethoxyresorufin-O-deethylase) towards the lower third of the river. The Gonadosomatic Index (100 * (Total weight / (Total weight - Gonadal weight))) shows an increase towards the lower third, however, the gonadal histology indicates a protoplasmic growth and reduction of the diameter of the different stages of development of the oocytes determined for this species (n = 2332, p < 0.05). On the other hand, the collected specimens show a difference in weight and length, presenting specimens of less frequency of length in the lower third with respect to those present in areas with less intervention. These responses are associated with the increase of the values of environmental parameters towards this zone. The results of this study indicate a gradient of adverse biological effects by the convergence of point and diffuse contamination complex chemical mixture and establishes the possible relationships between the physiological/reproductive alterations observed and the high degree of intervention of this river.

112 Poster spotlight: MO248, MO249, MO256

Sustainable Development Goals: the global context defining the agenda for government, business and academia

Can the Agenda 2030 and the Sustainable Development Goals be the drivers to change the world?

E. Giovanni, ASViS

How the SDGs are being addressed in Horizon 2020

M. Tamborra, European Commission - DG Research and Innovation

Examples of EU projects related to SDGs

M. Recchiuti, European Commission - EASME

Why SDGs are relevant for a large enterprise

A. Valcalda, ENEL

Conclusions

E. Tonda, UN Environment / Division of Technology, Industry and Economics (DTIE)

Questions and answers

Mercury Biogeoosciences: Fate, Effects and Policy

Rethinking Atmospheric Mercury Chemistry

M. Gustin, University of Nevada, Reno / Natural Resources and Environmental Science

Mercury (Hg) is considered a global pollutant. This is because it has a long atmospheric residence time. Because of the continued and increasing emissions of this pollutant to the atmosphere associated with anthropogenic activities, and the fact that once released from a geologic repository an atom of Hg may be potentially bioavailable for thousands of years, the Minamata Convention was developed and has come into force. The gaseous elemental Hg can be transformed into the atmosphere associated with anthropogenic activities, and the fact that once released from a geologic repository an atom of Hg may be potentially bioavailable for thousands of years. The Minamata Convention was developed and has come into force. This global treaty focuses on protecting human health and the environment from the adverse effects of mercury. There are 3 general forms in the atmosphere: gaseous elemental Hg, gaseous oxidized Hg (Hg(I) or Hg(II) compounds), and that bound to particles. Gaseous elemental Hg can be transformed to gaseous oxidized Hg (GOM) by a variety of atmospheric oxidants. Once generated, GOM is readily deposited to ecosystems. Understanding the chemistry of GOM is important for predicting deposition velocities, availability in ecosystems, and potential for conversion to methylmercury. Methylmercury is a subtle neurotoxin and is bio-accumulated in ecosystems. Recent work using cation exchange membranes in the University of Nevada Reno –Reactive Mercury Active System (UNR-RMAS), and an air Hg calibrator system (Utah State University) have demonstrated that the standard measurement method for GOM –collection on a KCl denuder- results in underestimation of GOM concentrations by 2 to 13 times. In addition, thermal desorption profiles of GOM compounds collected using nylon membranes indicate that different chemical forms exist in the atmosphere. Data collected in urban areas, in the marine boundary layer, and at high elevation indicate that GOM compounds present are influenced by oxidants present in the air.
Different oxidized forms are produced in the free troposphere, marine boundary layer, and due to local oxidants in urban areas. Understanding atmospheric chemistry of GOM is important for developing instruments that will accurately measure GOM, and helping guide policymakers in developing solutions for reducing Hg emissions and contamination of ecosystems.

120 Evaluating spatial dynamics and species variation on mercury and selenium molar ratios in Northeast Atlantic marine fish communities

A.M. Azad, NIFES / Contaminants and biohazards; S. Frantzen, B.M. Nilsen, A. Dunker, National Institute of Nutrition and Seafood Research / Contaminants and biohazards; L. Madsen, National Institute of Nutrition and Seafood Research / Seafood in modern times; M.S. Bank, Institute of Marine Research / Contaminants and biohazards; A. Maage, NIFES / Monitoring Programme

Seafood is the main dietary source of methylmercury (MeHg) exposure for humans and MeHg is a primary contaminant of concern for seafood consumption advisories. Co-occurrence of the Selenium (Se) and mercury (Hg) in seafood directly affect their bioavailability and toxicity. The protective and antagonistic effects of Se on Hg concentration is not well understood. The presence of both trace metals has been suggested to have antagonistic effects. Due to this reason, we analyzed total contaminants from the Baltic Sea, Norwegian Sea, North Sea, Skagerrak, North Atlantic and Norwegian fjords and coastal areas between 2006-2015. The mean Se levels ranged from 0.27 to 0.78 mg kg⁻¹ wet weight (ww) in Atlantic cod (Gadus morhua) and wolfishes (Anarhichas spp.), respectively. The mean Hg levels ranged from 0.40 to 0.77 mg kg⁻¹ ww with the lowest level in Atlantic mackerel (Scomber scombrus) and the highest in blue ling (Molva dipterygia), leading to variation in the mean Se:Hg molar ratios from 1.9 in blue ling to 43.2 in Atlantic mackerel with Hg levels contributing most to the variation. In general, pelagic species had the lowest Hg levels and the highest Se:Hg ratios whereas deepwater demersal species had the highest Hg levels and the lowest Se:Hg ratios. Most species had a large portion (more than 50%) of specimens with a Se:Hg ratio exceeding 5 except for tusk (Brosme brosme) (4% less than 1, 53% between 1 and 5) and blue ling (19% less than 1, 80% between 1 and 5). Se and Hg levels showed weak positive correlation (R from 0.24 to 0.70) in 13 of 17 species. The Se:Hg ratio was negatively correlated to fish length and Hg levels. Mean Se:Hg molar ratios varied across offshore areas for all species and a gradual decreasing trend was found for all species from north to south due to increasing Hg concentration and decreasing Se concentration. The EU maximum level of Hg and a Se:Hg molar ratio above one, we emphasize that fish from NEAO are generally safe regarding Hg contamination. Less than 1% of the total analyzed specimens had Se:Hg molar ratio less than 1 and the surplus Se may ameliorate the toxic effect of Hg to some extent.

121 The interaction of mercury and selenium across environmental media

J.R. Gerson, Duke University; L. Naslund, Duke University / Biology; H. Hsu-Kim, Duke University / Department of Civil Environmental Engineering; E. Bernhardt, Duke University / Biology

Both mercury (Hg) and selenium (Se) can bioaccumulate within aquatic ecosystems and are toxic to organisms when found at high concentrations. Individually, high concentrations of either Hg or Se can have severe impacts to biota, but the presence of both trace metals has been suggested to have antagonistic effects. Due to this relationship, many studies propose that increased environmental concentrations and consumption of Se is a pathway to reduce Hg toxicity in organisms. Yet, despite this important link, little is understood about the biogeochemical processes that promote this antagonistic relationship. In fact, only two published studies have simultaneously examined the interaction of Hg and Se in both multicellular organisms and environmental media containing microbes (sediment, water). In this study, we seek to better understand the uptake of Hg and Se into biota, as well as the biogeochemical conditions that promote this pathway and evidence for antagonistic effects. We use samples collected from the mountaintop mined region of West Virginia USA, where high concentrations of contaminants have previously been found in these watersheds. To answer this research question, we analyze total Hg (THg), MeHg, total Se (TSe), and Se speciation in water, sediment, biofilm, stream macroinvertebrate, and spider samples. Our results show that Hg, MeHg, and Se are bioaccumulating in the food chain, with the highest concentrations found in macroinvertebrates.

We also find that MeHg is an antagonistic compound to Hg concentrations and MeHg in bulk sediment and biofilm, suggesting that at high concentrations, percent MeHg in bulk sediment and biofilm are reduced. In crayfishes and spiders, we find a negative correlation between Se concentration and both absolute MeHg concentrations and percent MeHg. These results suggest that Se inhibition of MeHg accumulation might occur both at the microbial and macroinvertebrate levels of Bioavailability and realistic risk assessment of organic

122 Constraining Uncertainties in the Global Mass Balance of Mercury Using Observations and a Bayesian approach

S. Mustala, IIT Hyderabad; A. Qureshi, IIT Hyderabad / Civil Engineering

Uncertainties in global mass balance of mercury are constrained in this work using all the currently available observations of mercury species in the global environment, and a previously published multimedia model for mercury, UNIVOP3. Reducing uncertainties in mercury concentrations and mass balances with greater confidence. Ten key input parameters that were identified to be significantly contributing to the output uncertainties in previous studies. These included: emissions of mercury to the atmosphere, reduction and oxidation of mercury in surface and sub-surface oceans, and partition coefficients of mercury species groups (Hg(0), Hg(II), Hg-p) in surface and sub-surface oceans.

Then, a survey of literature on observations of mercury in the global environment is made. As these observations (for example, concentration of total mercury in air) are also key model outputs, we can update model inputs by comparing model simulated outputs to the actual observations. For this updating, a Markov chain Monte Carlo (MCMC) technique called Metropolis Hastings which is based on the Bayes rule is adopted. The observed concentrations of Hg(0) in atmosphere, dissolved gaseous mercury and total mercury in surface ocean are collected from published literature and used to obtain a likelihood function. Input parameters and their confidence range are revised. A revised mass balance is obtained through a forward Monte Carlo analysis using updated inputs. It is found that the uncertainties in key input parameters (such as partitioning of reducible divalent mercury between suspended solids and water in surface oceans) have been constrained to a considerable extent, e.g., phase-space limitation (P–P limitation). In relations between different mercury fractions (total methylated mercury – MeHg, and DGM), the most significant effort must be made in understanding mercury process in oceans rather than in conducting emission inventory exercises.

123 Effects of probable nutrient limitation on the relationship between mercury and marine microorganisms in seawater

I. Živkovic, V. Fajon, J. Kotnik, Jozef Stefan Institute; M. Solic, J. Lusic, G. Kusplić, Institute of Oceanography and Fisheries; M. Orduž, University of Split; F. Matic, B. Grbec, N. Bojanic, Z. Ninčević Gladan, Institute of Oceanography and Fisheries; M. Horvat, Jozef Stefan Institute

Microbial transformations of monomethylmercury (MMHg) and dissolved gaseous mercury (DGM) at the lower marine trophic levels are still not well understood. This is especially important in oligotrophic and nutrient-limited seas, where microbial food web and microbial loop dominate over classical (herbivorous) food web. Our research focused on the examination of the effects of probable nutrient limitation (P–P limitation) on relations between different mercury fractions (total methylated mercury – MeHg, and DGM) and autotrophic and heterotrophic microorganisms. We determined total mercury (THg), MeHg and DGM, along with relevant microbiological and chemical parameters in the Central Adriatic Sea. Using statistical analysis (non-numeric multi-dimensional scaling, principal component analysis, Pearson’s product-moment correlations), we assessed the microbial effects on Hg transformations and bioaccumulation. Only in the absence of P–P limitation conditions (P–P limitation), we found that MeHg was significantly related to both chemical and microbial parameters, which is an indication of metabolism-dependent Hg transformations. The activity of heterotrophic low nuclear acid bacteria seems responsible for most of Hg methylation in seawater under P–P limitation. Under P–P limitation conditions, DGM shows strong correlation with microbial fractions and chlorophyll a which, confirms previous research about biological DGM production. Contrary to MeHg, DGM transformations are probably not metabolically dependent, as most of these correlations can also be observed under P limitation. MMHg biomagnification from microeuston to mesozooplankton was observed through an increased biomagnification factor. Moreover, in the absence of P–P limitation, Hg transformations and uptake are probably enhanced under P–P limitation, which emphasizes its impact on Hg transfer to higher trophic levels. In order to test our nutrient-limitation hypothesis, we have performed statistical analysis on previously published data from the Southern Atlantic Ocean. We found similar correlations between MeHg (DGM) and physico-chemical characteristics of seawater under probable nitrogen limitation compared to those found under P–P limitation in our study. These results indicate that mercury methylation is impeded in seawater under probable nutrient limitations.

124 Poster spotlight: M0333, M0334, M0335

SETAC Europe 28th Annual Meeting Abstract Book
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in stagnant sediment: is multiple-thickness passive sampling the better alternative?
D. Gilbert, NGI / Environmental Technology; A.M. Oen, Norwegian Geotechnical Inst. / Environmental Technology; N. Berrojalbiz, Norwegian Geotechnical Institute / Environmental Technology; H. Arb, NGI / Environmental Technology
Passive sampling with thin polymer sheets is increasingly recognized as a superior alternative to enabling toxicokinetic risk assessment of nonpolar contaminants in sediment. For deducing true freely dissolved concentrations in the aqueous phase from measured polymer concentrations, the compounds are required to reach thermodynamic equilibrium between the polymer and the water phase. However, for in-situ deployment in stagnant sediment equilibration times are beyond practical time scales. The spiking of passive samplers with performance reference compounds (PRCs) has therefore been introduced as a way to deduce equilibrium concentrations from the release of PRCs over the deployment period. This approach relies on the assumption of isotropic exchange kinetics between the uptake of the native compounds into the polymer and the release of spiked PRCs from the polymer. Our aim was to test whether this assumption is valid in stagnant sediments in in-situ and ex-situ conditions, considering different types of sediment and PRC spike concentrations. For the field study, we immersed low-density polyethylene (PE) and silicone thin sheet passive samplers of multiple thicknesses and spiked with PRCs for 5 months into contaminated sediment in the Oslo harbour. For the ex-situ study, Oslo harbour sediment and Hortal harbour sediment was incubated with PRC-spiked PE under stagnant conditions at room temperature in the laboratory and samples were taken at various time points. From the PRC depletion field data, sediment porewater concentrations were modelled using the Fernandez-one-dimensional-diffusion model. In the field, equilibrium concentrations were modelled using a multiple thickness one-dimensional diffusion model. The ex-situ uptake and release data were modelled with a one-dimensional diffusion model (uptake) and a simple exponential one-compartment model (release). The model results showed for both in-situ data that the uptake and release kinetics were not identical. In addition, the ex-situ experiment revealed that PRC release kinetics is also dependent on the initial PRC spiking concentration. In conclusion, the data question the usefulness of PRCs for passive sampling in sediment, as the use of polymers of multiple thicknesses can produce results that are free from biases caused by anisotropic exchange kinetics.

126 Sediment toxicity of chlorpyrifos: whole sediment bioassay vs. silicon disc passive dosing
K. Walker, University of Amsterdam / IBED-ELD; N. Wieringa, University of Amsterdam/IBED Institute / FAME; M. de Baat, M. Kraak, University of Amsterdam / IBED-ELD; J. Parsons, University of Amsterdam / IBED-ELD; S. Droge, University of Amsterdam/IBED Institute / IBED
Realistic risk assessment of sediments polluted with organic contaminants is much more complex than tests with water samples. Physical and biological processes as well as contaminant bioavailability, may strongly influence the adverse effects on test organisms in whole sediment testing. The current work is the first of a series of studies in our group on whole sediment-equilibrated silicon rubber (ESR) that could allow for a major simplification of the assessment of the overall impact of organic contaminants in sediment. The aim of the current study was to demonstrate that ESR can transfer the chemical activity of the insecticide chlorpyrifos from spiked sediment to aquatic bioassay with ESR as a passive dosing material. The effect level of chlorpyrifos in a 28d whole sediment bioassay was comparable to effect levels observed in a 4d ESR passive dosing test using first instar larvae of the midge Chironomus riparius. Additional sampling with polycarbonate solid phase microextraction (SPM) fibers in both sediment and ESR dosed water was used to align the bioavailable concentrations in both tests designs. The ESR samplers accumulated chlorpyrifos up to 12% of the total spiked chlorpyrifos amount within 1 month. SPM samplers in sediment had 1-3x lower concentrations than SPIE equilibrated with ESR. Thus, the chemical activity in sediment as well as that released from the ESR in water were comparable within a factor of 3. The insecticide chlorpyrifos showed only slightly more toxic effect levels in a 28d whole sediment test than in the 4d ESR dosing assay. Bioavailable concentrations in SPM samples in both assays indicated lethally toxic freely dissolved concentrations in the range of 0.02 - 0.1 µg/L. This study suggests that the 4d ESR dosing assay with sensitive first instar midge larvae provides valuable and realistic insight in the toxic potency of insecticide contaminated sediment comparable to much more elaborate 28d whole sediment tests. Also, at lowest tested toxic insecticide levels, concentrations in SPM extracts were close to detection limits, so accurate measurements of safe bioavailable chlorpyrifos concentrations via SPM becomes problematic. This suggests that ESR dosing assays and chronic whole sediment studies could be used more effectively to demonstrate specific pollutant toxicity than chemical analysis of realistic sediment exposure levels.

127 Implementing desorption extraction methods into bioavailability-oriented bioremediation
R. Posada, IRNAS CSIC / Agroquimica y Conservacion del Suelo; J. Garcia, Instituto de Recursos Naturales y Agrobiologia de Sevilla CSIC; M. Cantos, IRNAS CSIC; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiologia / Agroquimica y Conservacion del Suelo
Regulators are starting to consider bioavailability within retrospective risk assessment frameworks for organic chemicals, however, implementation is not straightforward because the developments of bioavailability science have not always been translated into ready-to-use approaches for regulators. Possible pathways for translating bioavailability science into regulation of organic chemicals have recently been identified (Environ. Sci. Technol. 49:10255-10264, 2015). A simplified approach was proposed in which the assessments of soil/sediment and their chemicals should be based on two measurable values: the total extractable concentration and the bioavailable concentration as measured with robust and reproducible chemical and/or biological methods. One of the chemical methods which has been proposed to measure bioavailability of hydrophobic chemicals (HOCs) such as PAHs is the desorption extraction with Tenax during 20 h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integ. Environ Assess. Manag. 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retrofit contaminated land management but also prospective risk assessment applied in the approval and regulation of organic chemicals. With the aim of providing pathways for implementation into regulatory contexts, we carrying out desorption extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of slow degradation PAHs) were used to enrich the soil, soil, in order to decrease the fraction of bioavailable pollutants. The most relevant result in this study was that bioavailability increases in planted soils receiving thalnomolipids, as evidenced by Tenax extraction and it was accompanied by an increased biodegradation in soil slurries. In conclusion, tenax extraction during 20 h resulted a reliable and robust method to determine bioavailable concentrations in a wide set of operational conditions ranging from a different time scale to dissimilar treatments (planting, bioadjuvant application, etc.).

128 Prediction of very slow biodegradation of PAHs in soil and validation in a pilot of 25 years
R. Rietra, Alkterra and Wageningen University / sustainable soil management; J. Harmsen, Wageningen Environmental Research / CALM
Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and mineral has been followed during periods up to 25 years. Biodegradation took place on real scale fields (six landfarms and one depot) within the Netherlands. On these fields dredged sediments were bioremediated with PAHs. PAHs were present in concentrations up to 550 mg/kg d.m. (Dutch list). The objective of the investigation was to find experimental prove on the existence of long term biodegradation in field conditions. The measured data showed continuation of PAH degradation and this could be distinguished in 1) fast degradation in the first year 2) slow degradation in the following 6 years and 3) very slow degradation of PAHs from 6 years until at least 25 years. Knowing the long time necessary for biodegradation, it will be necessary to supply regulators with data and prediction to convince them that biodegradation will be a safe option to remediate the contaminated soil or sediment Bioavailability as measured with Tenax can be used to explain and predict the rate of biodegradation of PAHs. Three desorbing fractions can be measured. Tenax applied at 20ºC gives the fast desorbing fraction (uptake) and a simple exponential one-compartment model (release). The desorption fraction in the residue represents the very slow desorbing fraction. These are the same fractions as considered in the approach of Ortega-Calvo et al. (2015). In the soil, desorption makes the PAHs bioavailable and if conditions allow biodegradation (sufficient oxygen and water), this will occur. Using results measured in stored original sediment the different bioavailable fractions were measured and using a model with three first order derations (fast, slow and very slow) the really observed degradation curve could be predicted. Moreover, the fractions measured in present soils, shows that biodegradation will continue, however with a very small slow rate. Experiments applied in the nineties of last century had already shown that risks measured with bioassays were already not measurable after 6 years of landfarming. After 25 years the PAHs concentrations were 10 mg/kg d.m. or lower which made the soil reusable within the Dutch legislation.

129 Linking bioavailability of complex mixture to toxicity changes to assess recovery of contaminated soils
A six-month laboratory scale experiment was carried out to assess the effect of biochar and compost amendment on the behaviour and toxicity of tar mixtures in

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contaminated soils collected from two gasworks sites in the UK. Site 1 had a total polycyclic aromatic hydrocarbons (PAHs) concentration of 3500 mg/kg, and total aliphatic concentration of 1500 mg/kg. Site 2 had a lower concentration of both aromatic and aliphatic hydrocarbons 250 mg/kg and 350 mg/kg respectively. Heavy metals (HMs) concentrations in both soils ranged between 600 and 1200 mg/kg and the main elements were Zn, Pb and Cu. Both soils were amended with either 5% biochar or 15% compost in order to achieve metal stabilization and enhance soil degradation. The total amount of available concentrations of the studied metals in compost and HMs were determined after 0, 30, 90 and 180 days. Further to this microbial biomass, soil respiration, phospholipid analysis, Microtox toxicity, earthworms’ lethality and seeds germination were carried out to assess how ecological health changed as the soils underwent remediation treatments. The study showed that, for both soils, microbiota amended with compost showed the most significant reductions in toxicity. The microbial number and respiration activity increased by two orders of magnitude after compost addition. Conversely, there was no significant difference between non-treated and biochar amended soils. At the onset of the experiment, no seed germination was observed in Soil 1 (non-treated) whereas an increase in seed germination was observed after 90 days for mustard and rice grass, and after 30 days for peas. The compost treatments had the highest percentage germination for both soils across all seed types. Similarly, the earthworms assay showed there was significantly greater survival rate at the end of the experiment compared to the onset. The biochar treatment resulted in a lower survival counts compared with compost treatment, with the non-treated samples having the lowest results. Preliminary results suggest that addition of compost and biochar accelerated the degradation rate of hydrocarbons component and contributed in reducing toxicity of the soils. The degradation of PAHs and re-distribution of HMs will be evaluated with a multivariate analysis; data will be explored to highlight associations between contaminant’s concentration (reduction) and its influence on biological properties and toxicological responses in mixed contaminated soils.

130 Impact of Biochar Additions to Soil on Contaminant Sorption and Plant Bioavailability

W.J. Doucette, Utah State University / Utah Water Research Laboratory; J. Finningski, D. McAvoy, Utah State University

Reclaimed water is increasingly used in arid and semi-arid regions for irrigation. Contaminants in the reclaimed water, (e.g. pharmaceuticals and personal care products (PPCPs) and metals) could accumulate in exposed crops. Biochar is a potentially cost-effective soil amendment and contaminant sorbent that could reduce the plant bioavailability of reclaimed water associated contaminants. But few studies have been conducted to test the behavior of certain contaminants like undergoylisation (dehydration) at high temperatures with no oxygen). The main objective of this study is to investigate the impact of wood biochar on the crop bioavailability of selected PPCPs found in reclaimed water. A secondary objective is to quantify the contaminant sorption-desorption characteristics in the amended soils and to determine if there is a relationship with plant bioavailability.

PPCPs were selected as target contaminants because of their widespread occurrence in reclaimed water and their potential impact on animals feeding on the irrigated crops. Target PPCPs were selected based on chemical properties, widespread use, frequent detection in WWTP effluent, and potential risk to the environment. The target PPCPs represent a range of therapeutic uses including antibiotics linked to antibiotic resistance in bacteria (sulfanilamide (SMZ) and triclosan (TR)), an anti-inflammatory that prevents seizures and relieves nerve pain (carbamazepine), an antidepressant (fluoxetine (FLX)), and an antihypertensive (glibenclamide (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and has been used in a number of sorption studies with biochar. Pinyon Juniper, Russian Olive, and Lodgepole Pine derived biochars were chosen because they contributed in reducing toxicity of the soils. The degradation of PAHs and re-distribution of HMs will be evaluated with a multivariate analysis; data will be explored to highlight associations between contaminant’s concentration (reduction) and its influence on biological properties and toxicological responses in mixed contaminated soils.

131 LCIA method development in a global perspective: Status and outlook (II)

131 A novel framework for a new generation of water consumption indicators in LCA and footprint studies

M. Núñez, TU Berlin / Sustainable Engineering; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Institute of Materials Science and Technology for Environment and Agriculture (IMTM); E. Loiseau, Irstea; M. Núñez, TU Berlin / Sustainable Engineering; N. Lamouroux, E. Loiseau, Irstea; M. Núñez, TU Berlin / Sustainable Engineering - Institute of Materials Science and Technology for Environment and Agriculture (IMTM)

Available freshwater consumption indicators for use in LCA and water footprint studies implemented in LCA software are based on either a volumetric approach of the water consumed (what we called first generation of indicators) or on stress-indicators (what we called second generation of indicators). The first generation only performs an inventory and thus a partial footprint assessment according to ISO 14046, while the second generation shows limitations in describing the consequences of a lack of water at the endpoint. To date, no LCA method comprehensively distinguishes water masses (e.g. surface water and ground water) and water transfers (from one reservoir to another) within the boundaries of a watershed (e.g. evaporation) and beyond (e.g. groundwater and air advection), thus overlooking details in hydrological processes that affect environmental relevance of the assessment. In addition, a structured LCIA framework is currently lacking, as can be observed by the scattered and often incompatible developments of water fate and impact assessment models published in recent years. These models are all valuable contributions in themselves, but impossible to combine into an integrated global characterization model that makes such developments operational in LCA.

The challenge of improving environmental relevance of current water consumption indicators has been tackled by the Water Use in LCA (WULCA) working group within the UN Environment Life Cycle Initiative by developing consensus-based guidelines for the third generation of water consumption indicators, with a focus on common approaches of water consumption and environmental impact assessment. In addition, the new generation of indicators is also available. The new generation of indicators includes the concept of footprint, which is based on current and future methods under a unique framework and to enhance the environmental relevance of the water use impact category in LCA.

132 A midpoint indicator for freshwater resources

C. Pradinaud, IRSTEA Montpellier / ITAP ELSA; G. Junqua, Ecole des Mines d’Alès / LGEI; P. Roux, Irstea / ITAP ELSA-PACT; A. Hélias, Montpellier SupAgro / LBE ELSA; Y. Penru, SUEZ groupe / CIRSEE; R.K. Rosenbaum, IRSTEA Montpellier / UMR ITAP ELSA

Flashinski, D. McAvoy, Utah State University

Freshwater resource has been recognized as being a safeguard subject within the Analysis of Protection (AoP) natural resources (WULCA resource group framework). Besides depletion also long-term pollution threatens the sustainability of freshwater resources, but currently no LCIA model links emissions to potential damage on freshwater as a natural resource. This study proposes a characterisation model to assess the potential impacts on freshwater resources generated by persistent changes in water quality caused by chemical emissions. The relevance of this new approach regarding the methodological issues of long-term (toxic) impacts is also discussed. As recommended in the WULCA freshwater resources framework the concept of recovery period is used: when the recovery period lasts longer than a given period of time, potential impacts to freshwater resources (i.e. affecting freshwater availability for future generations) need to be considered. Based on literature review, we set the time period at 100 years, which requires a dynamic fate model. The dynamic fate model has then been linked with the dynamic version of the USEtox® model. This provides the time-integrated pollutant mass remaining in the freshwater compartment (at continental scale) after 100 years (in kg/day).

LCIA method development in a global perspective: Status and outlook (II)

131 A novel framework for a new generation of water consumption indicators in LCA and footprint studies

M. Núñez, TU Berlin / Sustainable Engineering; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Institute of Materials Science and Technology for Environment and Agriculture (IMTM); E. Loiseau, Irstea; M. Núñez, TU Berlin / Sustainable Engineering - Institute of Materials Science and Technology for Environment and Agriculture (IMTM)

Several life cycle impact assessment (LCIA) models have been proposed to
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (III)

134 The use of dynamic stock model to the definition of characterisation factors for biotic resources depletion

A. Hélias, Montpellier SupAgro / LBE ELSA; J. Langlois, Université Paul-Valéry Montpellier 3 / CEF UMR CNRS Université de Montpellier Université Paul-Valéry Montpellier EPHÉ Université PaulValéry Montpellier Montpellier cedex France; P. Fréd., IRD, emirits scientist

Biotic natural resources have received little attention by the LCA community and this tempers the use of LCA for fish based food and feed products. Current LCA methods do not assess the impact of biotic components on aquatic ecosystems. The dynamic of biotic stocks (i.e. population) is a well-studied topic in theoretical ecology and it is commonly used for fish stocks management. The main challenge in applying HCP globally is due to hydrological and hydraulic data availability. It is however possible to find convergence between European and extra-European species habitat preferences. The proposed model is a promising effect factor for mechanistic impact characterisation which should be integrated with fate factor models describing hydrological alteration at a compatible spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

135 Accounting for soil quality effects of agricultural land management in LCA

B. Lieselet, R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Van Linden, Flanders research institute for agriculture, fisheries and food / Technology and Food Science Unit; T. Galle, D. Pittois, Luxembourg Institute of Science and Technology LITT; A. Christen, J. Hansen, University of Luxembourg / Faculty of Science, Technology and Communication

The growing demand for food and feed has put a pressure on the agricultural sector, which resulted in agricultural intensification. This entails many adverse environmental impacts and takes a huge toll on land resources; which can result in land degradation. Especially farm management can affect soil quality (e.g. soil organic carbon, SOC) by for instance the choice of crop rotations. The agricultural sector is therefore forced into a more sustainable approach. To assess the environmental sustainability, life cycle analysis (LCA) is a powerful tool. As soil quality is an inherent aspect of agricultural sustainability, life cycle impact assessment (LCIA) methods should account for the effect of agricultural land management on soil quality. Despite a lot of efforts that have already been made, there are still several research needs on the integration of soil quality effects in LCIA methods. Ideally, inventory data are translated into the effect on the environment by indicators moving along the cause-effect chain from mid- to endpoint towards an area of protection (AOP). Although soil quality changes are often related to the AoP ecosystem health, we focus on the AoP natural resources as we refer to the impact of land management on soil by the long-term ability to produce biomass. To improve the usefulness in the agricultural sector, different land use intensitites should be distinguished. We therefore introduce three interdependent LCIA indicators. At early midpoint, SOC changes (SOC1 indicator 1) are used to indicate the long-term effect of agricultural land use on soil. This can result in biomass productivity losses (BPL indicator 2). At endpoint, we propose additional land requirements (ALR indicator 3) as indicator, which corresponds to the area needed to produce the yield that has been lost. To calculate characterisation factors (CFs), we chose as reference situation the highest achievable SOC stock and yield, which are calculated for each initial soil quality stock. The models RothC and EU-Rotate N are used to quantify SOC stocks and yields, respectively. CFs are developed for several rotation systems in Flanders. Though, the elaborated framework is generally applicable and allows the calculation of CFs for other regions. Thanks to the use of an achievable reference situation and a distinction between land management strategies (good, bad and standard practices), the indicators can be a useful tool to strive for a more sustainable agriculture.

136 Poster spotlight: MO093, MO094, MO106

Screening of wastewater-borne pharmaceuticals and their phototransformation products in rivers

S. Perez IIQAB / Department of Environmental Chemistry; D. Barcelo, CSIC / Environmental Chemistry; D. Barcelo, CSIC / Environmental Chemistry; D. Barcelo, CSIC / Department of Chemical Engineering

Poster spotlight: MO093, MO094, MO106

Pharmaceuticals are continuously discharged into the rivers from wastewater treatment plants. Though, the elaborated framework is generally applicable and allows the calculation of CFs for other regions. Thanks to the use of an achievable reference situation and a distinction between land management strategies (good, bad and standard practices), the indicators can be a useful tool to strive for a more sustainable agriculture.
performed in a first stage and then in the next step studies are conducted directly in the natural environment. In our group, we proposed a workflow using the combination of HRMS and processing software for evaluating the phototransformation of pharmaceuticals on a single compound basis under simulated and real environmental conditions. In contrast to this compound-by-compound approach, in the new approach presented here, degradation was not assessed for a single compound but instead a cocktail of human drugs was subject to the transformation process. Following the identification of photo-TPs, a list of suspect TPs was created and used to screen them in SPE-concentrated river water samples. For the generation of photo-TPs, reconstructed surface water was spiked with a cocktail of 34 pharmaceuticals at concentrations of 10 μg/L and exposed to artificial light in a sunlight simulator. Unprocessed HR-MS/MS (1) generation of photo-TPs via subsequent surface water samples originating from rivers were screened for their presence. For the enrichment of the potential photo-TPs, water samples were preconcentrated on four SPE cartridges connected in series and then analyzed using the same system mentioned above. With this methodology more than 30 photo-TPs were detected in the irradiated reactor samples. As of the time of submission of this abstract, the identification and some of the photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

139 Degradation of a polymer probe exposed to different wastewater environments: Linking chemical transformations and potential microbial consumers
A. León, M. Tiberio, CSIC - Spanish National Research Council / Environmental Chemistry; M. Vila-Costa, B. Zouja, IDAEA-CSIC / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry, D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry.

The objective of the present contribution was to link the chemical transformations observed in a polymer probe exposed to the different aquatic environments found in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (AER) and in the anaerobic reactor (ANA). Results suggest that polymers select specific microbial groups that are able to degrade higher molecular weight compounds. The enrichment of the potential photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

140 Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based Disinfectant
A.S. Leclerc, Universite de Sherbrooke / Civil Engineering

In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problems which has affected the potential recycle and reuse of wastewater for domestic or industrial usage. Selection appropriate treatment approach has played an important role not just to reach discharge limits, it is also important to decrease human footprints in the environment. Some hydrolytic and oxidative enzymes (i.e., Laccase) is capable of oxidizing unreactive iodide to reactive iodine, when they can play roles to degrade recalcitrant pollutants in wastewater. The resulting iodine represents a powerful antimicrobial compound. The aim of this study is investigating the potential of acetophenone and phenolic organic contaminant acetylamino phen as mediator in a laccase mediator system to generate disinfectant iodine. The stability of reaction can be changed depending on the pH, temperature and multiple compound existence and system optimization is required to stabilize iodine synthesis. In this study, two different free laccases and insolubilized as cross-linked enzyme aggregates have been tested. Alcoholic synthesis is investigated with different KI (0.02 M) concentrations and different KI concentration (5, 10, 30 and 40 Unit/L) for 5 hours. Compounds were injected in distilled water as well as in the influent and effluent samples of wastewater treatment plants to see synthesis of iodine while the micropollutants have been removed in Laccase Mediator System. In the experimental sets, removal of persistent compounds were determined by liquid chromatography tandem mass spectrometry (LC/MS/MS). 1 generation of photo-TPs via subsequent surface water samples originating from rivers were screened for their presence. For the enrichment of the potential photo-TPs, water samples were preconcentrated on four SPE cartridges connected in series and then analyzed using the same system mentioned above. With this methodology more than 30 photo-TPs were detected in the irradiated reactor samples. As of the time of submission of this abstract, the identification and some of the photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

143 Framework for building national inventories of toxic emissions to air, water and land in Europe
A.S. Leclerc, DTU / Management Engineering; S. Sala, M. Secchi, A. Cerutti, Université Paris Dauphine / Testing & Analysis; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry; M. Vila-Costa, B. Zouja, IDAEA-CSIC / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry, D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry.

The objective of the present contribution was to link the chemical transformations observed in a polymer probe exposed to the different aquatic environments found in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (AER) and in the anaerobic reactor (ANA). Results suggest that polymers select specific microbial groups that are able to degrade higher molecular weight compounds. The enrichment of the potential photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors

A. S. Leclerc, DTU / Management Engineering; S. Sala, M. Secchi, A. Cerutti, Université Paris Dauphine / Testing & Analysis; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry, D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry.
European Commission Joint Research Centre / Bioeconomy unit; A. Laurent, DTU / Division for Quantitative Sustainability Assessment DTU Management Engineering

The European Inventory of Existing Commercial chemical Substances (EINECS) lists over 100 000 chemical substances used on the market. Over 16 000 chemical substances have been registered in REACH since 2008. In comparison, only ca. 3 000 different substances were found in life cycle impact assessment (LCIA) to express their potential toxic impact on human health (cancer and non-cancer effects) and freshwater ecosystems. Because of human activities, those pollutants may enter the environment in several different ways: they are emitted to air from the combustion of materials, released through wastewater from industries and households, applied to soils together with manure and pesticides, etc. Combined with the difficulty of availability of release data, the sheer number of substances and the large variety of emission sources are challenges that one needs to overcome to quantify the overall toxic impacts of a country. Here, we therefore propose an updated methodology to build national inventories of toxic emissions in EU Member States in 2000-2014. The framework builds on earlier works and differentiates environmental compartments (air, water and soil) as well as anthropogenic sources (industries, households, manure and pesticides application on agricultural soils). It relies on existing and publicly available data, and extrapolation techniques are developed and used to fill in the gaps across countries in the entire period 2000-2014. The resulting harmonized inventories cover more than 500 substances, including both organics and inorganics such as persistent organic pollutants and heavy metals. Albeit still limited in substance coverage, it is thus possible to analyze the contribution of each substance and anthropogenic source to the toxic impacts on human health (human toxicity) and freshwater ecosystems (freshwater ecotoxicity), using LCIA methods such as the consensus model USEtox.

144 Combining economic modelling and LCA to assess regional policies: key findings from a case study on the French forestry sector
T.B. Beussisseur, INRA; E. Loiseau, Irstea; S. Caurla, INRA
Economic modelling is increasingly used in Life Cycle Assessment (LCA) to perform consequential LCA for the environmental assessment of product and services. Economic models can also provide significant enhancements for assessing the effects of regional policies, such as in territorial LCA approaches. Among them, equilibrium models appear as a good compromise to assess both socio-economic and environmental impacts of regional policies in an exhaustive and representative way. However, there are still some bottlenecks when trying to combine both approaches in practice. For instance, the levels and distribution of inputs and outputs for the two different approaches are required to ensure a consistent combination while limiting the time spent to collect data. This talk aims at providing insights on the combination of a partial equilibrium model, the French Forest Sector Model (FFSM), and LCA to assess the eco-efficiency of two regional policies supporting local wood industries in the French East Region. Two approaches will be used to combine economic models with Life Cycle Inventories (LCI), i.e. i) the Extended Environmental Input Output modelling and ii) a method based of MFA (Material Flow Analysis) and process-based LCA. Eco-efficiency ratios based on economic and environmental impacts allow identifying scenarios with best environmental performances. In addition, this combination allows considering supply and demand dynamics, and thus the socio-economic effects of a decision. Using two different approaches, we are able to compare strengths and weaknesses of both types of combinations and discuss them considering policy assessment results, system representation and system boundaries. Thus, our work provides both insights on down-to-ground policy analysis and methodological developments on combining economic modelling with LCA. Here, economic modelling outputs are used as LCA inputs but more integrated modelling could be performed for completeness and optimization purposes. Perspectives on a stronger coupling will also be discussed.

145 A regional life cycle approach for assessing the climate change mitigation potential of biodiesel products
S. OKeefe, Helmholtz centre for environmental research - UFZ / BEN; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; U. Franko, Helmholtz Centre for Environmental Research, UFZ / Department of Soil Physics; D. Thraen, Helmholtz Centre for Environmental Research UFZ/ Deutsches Biomasseforschungszentrum gemeinnützige GmbH, DBFZ / BEN.

Keywords: Regional, spatial, biobased economy, GHG While traditional life cycle assessment is a powerful tool, for spatial applications, it is limited. With the ever increasing drive towards regional biobased circular economies, as a means of ensuring future climate change mitigation, there is a need to produce more regional and spatially representative life cycle assessments of biobased systems and bioeconomy regions. “RELCA”, a Regional Life cycle inventory approach, was developed to assess the regional and spatial variation in the environmental performance of bioenergy production within a focus region. Through the use of catchment delineation, conventional geographical modelling is combined with life cycle software to assess the potential environmental burdens of regional bioenergy configurations (i.e. bioenergy plants and their biomass catchments). RELCA was used to assess the climate mitigation potential of biodiesel, for the region of Central Germany. With this approach we showed, for the focus region, that the mitigation potential changed between the different biodiesel configurations, due to their location within the region. When compared to a fossil diesel combinator (83.8 CO2 eq./MJ), the climate change mitigation potential of the regional biodiesel ranged between 53%-62%. When the results were compared to the typical RED (Renewable Energy Directive) values, a 13-31% greater mitigation potential than the RED was observed. The latter, indicating that regional variability cannot be captured with a simple regional average value or default value. Additionally, scenarios were tested to show the mitigation potential of reduced nitrogen fertiliser application during the biodiesel production phase. The results indicated that while reduced nitrogen fertiliser led to emission reduction per hectare, the greater land area input required to meet the demand of the biodiesel plants, led to an increase in emissions ranging from 1.14-5.71 g CO2eq/MJ biodiesel. Thus, highlighting that assessments of biobased systems should consider configurations of biomass and conversion plants in order to determine appropriate mitigation strategies. Therefore, the ability to account for the territorial and geographical characteristics found within a region, using life cycle approaches, is important to support more sustainable regional resource management.

146 LCA_WIND_DK: temporally, geographically and technologically-sensitive life cycle inventories for the Danish wind turbine fleet
Economic performance of a wind turbine is usually calculated as the ratio of the life cycle impacts over the wind turbine production phase. The obtained results generated from different scenarios indicated that while reduced nitrogen fertiliser led to emission reduction per hectare, the greater land area input required to meet the demand of the biodiesel plants, led to an increase in emissions ranging from 1.14-5.71 g CO2eq/MJ biodiesel. Thus, highlighting that assessments of biobased systems should consider configurations of biomass and conversion plants in order to determine appropriate mitigation strategies. Therefore, the ability to account for the territorial and geographical characteristics found within a region, using life cycle approaches, is important to support more sustainable regional resource management.

147 Assessing environmental impacts of individual households: A large-scale bottom-up approach
A. Froemelt, ETH Zurich; R. Buffat, ETH Zurich / Institute of Cartography and Geoinformation; N. Heeren, S. Hellweg, ETH Zurich / Institute of Environmental Engineering
Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur over the whole life cycle of the product and supply chain. Therefore, assessing environmental footprints of households is an important basis to identify environmental policies. This study aimed to develop a comprehensive regionalized bottom-up model for Switzerland that is able to assess the environmental impacts induced by individual households. The purpose of this model is to provide a virtual platform for detailed scenario analysis which shall support effective political decision making on different scales. Three existing bottom-up models were merged: a building stock energy model, an agent-based transport simulation and a household consumption model. All of them were tested and evaluated beforehand. The physically-based building Energy model establishes
simplified energy balances for each residential building based on spatially and temporally resolved climate data, building characteristics and 3D-geometries. It provides estimates of space heating, hot water and electricity demand for each household. The mobility sub-model builds upon the results of an agent-based traffic simulation framework which was applied to Switzerland and reproduces mobility patterns of Swiss inhabitants in space and time. The third sub-model provides a data-driven approach and enables the quantification of consumption of food, consumables, and other goods and services for each Swiss household by means of data mining techniques. Linking these sub-models with environmental background data allowed for computing an environmental profile for each household in Switzerland. The application of this model to the current situation of Switzerland reveals interesting differences between individual households, district regions and different correlation areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from enhanced refurbishment programs to future mobility solutions such as autonomous vehicle systems.

148 Poster spotlight: MO109, MO110, MO113

Mechanistic effect modelling for risk assessment: applications, use in a regulatory context and future directions

149 Modelling ecological scenarios for the assessment of chemical effects on stream communities
A. Gergs, Bayer AG - Crop Science Division / Department of Environmental, Social and Spatial Change; S. Classen, K. Ladermann, Research Institute gaiac; T. Strauss, M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

The ecological risk assessment of chemicals (ERA) aims at quantifying the likelihood of adverse ecological effects posed on populations and the communities they comprise. Effects caused by the exposure of organisms to chemicals can however to a great extent depend on environmental scenarios as well on the states, behaviours and interactions of organisms with consequences for individual life history, population responses and community dynamics. In this regard, our major objective is to suggest how to model stream ecological scenarios for ERA. We suggest to employ ecological classifications as defined within the Water Framework Directive. Here, the ecological scenario is a virtual representation of an ecosystem, which involves both abiotic components (habitat scenario) and biotic components (the functional and life history scenario). Technically, we integrate spatial explicit habitat information in form of raster maps, temporal information on abiotic factors like temperature and chemical exposure, functional trait data bases, dynamic energy budget models and process based effect models to simulate macroinvertebrate and fish assemblage dynamics. In model applications, we explore to what extent the ecological scenario will affect the adverse outcome of chemical exposure.

150 Robust implementation of TKTD models with Bayesian inference
V. Baudrot, Université Lyon 1; S. Charles, Université Lyon 1 / Laboratory of Biometry and Evolutionary Biology

The application of toxicokinetic-toxicodynamic (TKTD) modeling proved to be of particular interest in strengthening the Environmental Risk Assessment (ERA) of chemicals compounds (e.g., REACH dossier accounting for toxicity of industrial discharge, evaluation of impacts of Plant Protection Products (PPP), ...). TKTD models describe the time-course of processes leading to toxicity at the level of organisms. These models include all mechanisms from the toxicokinetics part describing the compound fate from external concentration to internal kinetics (e.g., exposure, uptake, elimination, biotransformation, internal distribution), and translate the internal concentration into toxicodynamics covering alteration of cells and organs functioning that can eventually lead to a toxic effect at the organism level (e.g., mortality, reduced reproduction, abnormal behavior) then affecting the population dynamic. Infor survival analysis of organisms in response to a chemical stressor, the Generalized Unified Threshold model of Survival (GUTS) is today recognized as a suitable and powerful TKTD framework incorporating two complimentary death mechanisms: Stochastic Death (GUTS-SD) and Individual Tolerance (GUTS-IT), from which a large range of existing models can be derived. Intergovernmental institutions as the OECD have acknowledge the necessity of TKTD models for ERA improvement, but while an integrative mathematical framework as GUTS offers an efficient theoretical approach, its practical use is challenging (from model implementation to parameter estimation), especially with time-variable exposure. The Bayesian approach has multiple advantages as (i) using all data provided by the experiments, (ii) taking into account the knowledge from experts and/or previous studies, (iii) being relevant for complex model with small dataset since there is no degree of freedom, and (iv) a clear handling of uncertainties by providing distributions of parameter posterior. nTo ease the access of Bayesian fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS models with R to software packages R2BayesX and PyMC3. To assess the Bayesian vs. R2BayesX framework, we performed 400 iterations of the widespread statistical language R (JAGS and Stan). Then, we embedded those algorithms within two R packages with the core idea to be user friendly (e.g., using experiment design to define priors). A side result is to propose a step-by-step approach to perform Bayesian statistics in ecotoxicology.

151 Can TKTD-models describe and predict synergistic interactions in Chironomus riparius?
K. Dalhoff, University of Copenhagen / Department of Plant and Environmental Sciences; G. Bellisai, European Food Safety Authority EFSA; E. Neira, N. Cedeezreen, University of Copenhagen / Department of Plant and Environmental Sciences

The azole fungicides propiconazole and prochloraz are known to enhance the toxicity of pyrethroid insecticides like α-cypermethrin during co-exposure. The development of these synergistic actions in the waterfly Daphnia magna have recently been modelled using toxicokinetic (TK) and toxicodynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study was to predict the same effects with TKTD-framework for synergistic interactions in D. magna can be applied to the midge larvae Chironomus riparius to describe development in survival rates and the underlying mechanisms over time when co-exposed to azole fungicides and pyrethroid insecticides. Toxicity of the individual compounds was tested using a pulsed concentration response design with an initial 24 hour exposure period followed by six days of recovery in clean medium. To assess the potential interactions with the azoles and α-cypermethrin were a range of tests conducted with co-exposure to 1, 3, 10, 30, or 100 µg L⁻¹ of propiconazole or prochloraz and 2.5, 5.0, or 10.0 µg L⁻¹ of α-cypermethrin. For the TK-modelling will uptake and elimination rates of the individual compounds in C. riparius be measured to parameterize the TK-model before applying the internal scenario to the observed effects. We hypothesise that the synergistic interactions can be described and modelled by adding a synergy parameter $\nu$ to the biotransformation rate constant for α-cypermethrin and that the value of this $\nu$ parameter will depend on the azole exposure concentration. The preliminary results indicated time-dependent synergistic interactions in C. riparius as previously observed in D. magna, but also a higher sensitivity of C. riparius towards the fungicides with 168 h EC₅₀-values for the 24 h pulse exposure of 1.06 ± 0.27 and 0.28 ± 0.10 µmol L⁻¹ for propiconazole and prochloraz, respectively. This is surprising as previous non-published data indicated that C. riparius has an approximately 10 fold faster initial elimination rate of the azoles compared to D. magna. We expect that our TKTD models will be able to explain these kinetic differences and how they relate to the observed toxicity. We further suggest that it is likely to be possible to predict the effects of exposure to azole and pyrethroid pulses with varying time intervals between the pulses.

152 Integration of temperature-dependent TKTD kinetics in individual-based population modelling - A case study with Chaoborus crystallinus
T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

The toxicokinetic-toxicodynamic (TKTD) model framework GUTS is increasingly used and becoming the standard effect model in regulatory risk assessment. However, this model is mostly used without the temperature dependency of TKTD kinetics, and effect measurements are usually performed in the laboratory at 20°C. This approach is rather unrealistic, especially in outdoor scenarios with significantly different water temperatures over the year: On the one hand, in cases with low water temperatures during autumn and winter, the toxic effects can be reduced or delayed, while on the other hand, the degradation of the substance is often slowed down, which increases the exposure time. But also at higher temperatures than 20°C, increased toxic effects on organisms are to be expected. In this presentation, the influence of seasonal temperatures on toxicity at the population level is exemplarily examined. For this purpose, an individual-based population model for the phantom midge Chaoborus crystallinus is used. This has been intensively tested using outdoor aquatic mesocosm studies, and has been linked to the TKTD framework with GUTS, which has been extended by a temperature dependency based on laboratory data. Temperature dependencies of lethal effects on C. crystallinus larvae exposed to the pesticide chlorpyrifos and the fate of chlorpyrifos were measured in the laboratory in the range of 4-20 °C. These data are used to parameterize the GUTS, and subsequently to simulate the population dynamics of Chaoborus under variable outdoor temperature conditions. The Chaoborus model was used with and without the implemented temperature dependency of the effect model to assess whether toxic effects on a Chaoborus population are increased or decreased depending on the temperature conditions. Therefore representative summer and winter exposure scenarios were selected.
Using temperature dependencies for the relevant biological and toxicological processes, this modelling approach allows a more realistic risk assessment of pesticides for populations in the field.

153 Assessing lethal and sublethal effects from time variable exposure for different life stages with the DEB model: an example for a Pythroid in rainbow trout E. Zimmer, IBACON GmbH; T. Preuss, Bayer Ag / Environmental Safety; S. Norman, RidgewayEco; B. Minten, ADAMA Deutschland GmbH; V. Ducrot, Bayer Ag / Environmental Safety Ecotoxicology

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-TD modelling. As part of the risk assessment modelling is used as a supporting tool to back up the experimental results and as an investigation tool to better understand the mechanisms of effects of beta-cyfluthrin. Beta-cyfluthrin is acting as neurotoxicant in fish for which the severity of effect depends on the magnitude and duration of the exposure peak. To address these characteristics, the effects of beta-cyfluthrin on rainbow trout were evaluated with two independent early life stage tests (ELS): a standard Tier 1 study with constant exposure and a Tier 2c study under time variable exposure. Observed effects differed in these two studies. Under constant exposure, severe mortality and significant growth effects were observed while under peak exposure, no effects on survival were observed, and only negligible effects on growth were found. The model was successfully calibrated using the constant exposure experiment, and then accurately predicted the effects observed in the peak-exposure assay. The model accurately predicted the sublethal effects in the fish does not pass the threshold for an effect on survival. This helps to explain why no mortality is observed in the peak exposure experiment. The no effect threshold for sublethal effects is passed in the modelling under constant exposure, which is consistent with the observations. In the peak experiment, the duration of the effect on the feeding behaviour is insufficient to induce large effects on growth in weight or lengths, because beta-cyfluthrin is rapidly removed from the bloodstream and the fry have difficulty to cope with reduced feeding over a short period. The modelling supports the experimental finding that under realistic exposure conditions, short term effects on the feeding behaviour do not lead to growth or survival effects, and gives a mechanistic explanation for this observation. We were able to derive a mechanistic explanation for the results from laboratory experiments conducted with three different early life-stages of the trout, and for different exposure profiles to beta-cyfluthrin. The model shows that results from both laboratory studies are consistent. This validated model has the potential to be used to make accurate in silico predictions of effects on fish early life stages from time-variable exposure profiles.

154 Prediction of effects on chemicals on three-spined stickleback populations in mesocosms V. David, INERIS; B. Goussen, University of York / Environment; J. Porcher, INERIS / INERIS UMRI SEBIO ECOT; R. Beaudouin, INERIS / Models for Ecotoxicology and the internal METEO

To improve environmental risk assessment, mechanistic models predicting the impacts of toxicants on populations such as individual-based models (IBM) was suggested as relevant tools. Furthermore, IBM can be coupled with DEB (Dynamic Energy Budget) models which describe physiological processes of an organism. However, the development of DEB-IBMs requires a large number of data on the organism and population dynamics which make them difficult to build. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One of the species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this teleost fish is relatively well documented from the food data was tested in order to assess the relevance of the DEB model calibrated using the constant exposure experiment. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One of the species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this teleost fish is relatively well documented from the ecology and biology of this teleost fish is relatively well documented. This approach removes operator bias while allowing for the chemical identification of all microP >3μm in size in a sample. To validate RSI for the identification of microP, >3μm in size using a Raman Spectral Imaging (RSI) protocol which has been developed for chemical analysis sampled from the environment. RSI is an improved identification rate could be achieved by eliminating the dilution step. This RSI protocol will be utilised for the analysis of samples collected from a month-long monitoring campaign at an urban background site in London, UK.

156 Analysis of polystyrene based microplastics in the environment G.F. Schirinzii, IDAEA-CSIC / IDAEA; M. Farre, IDAEA-CSIC / Environmental Chemistry, m. farre-urgell, IDAEA-CSIC; D. Barcelo, IJJAB-CSIC / Department of Environmental Chemistry Marine anthropogenic litter is a severe environmental problem. Wastes discarded or deposited in aquatic environments (including rivers, estuaries and coastal waters) usually consist of metal, glass, wood and plastic, being the 80% of these plastic wastes. One of the main issues is the extreme stability of plastic wastes. Under environmental conditions, the erosion of these materials generates smaller fragments some of them in the nano- and microscopic scale, which are known as microplastics (NPLs) and microplastics (MPLs), respectively. The quantitative analysis of these plastic micro-fragments is particularly difficult because of their physicochemical properties (low solubility, a wide range of molecular weights, etc.) and potential contaminations sources in the laboratory. For these reasons, different approaches should be considered to find a standardised protocol for the determination of MPLs and NPLs in the environment. In this context, this study was focused on the investigation and practical comparison and combination of different analysis tools for the quantitative and qualitative analysis of MPLs and NPLs using: (1) techniques to assess the physicochemical properties such as Thermogravimetric Analysis or TGA, Diffierential Scanning Calorimetry or DSC, and Fourier-Transformed Infrared Spectroscopy or FT-IR; (2) quantitative and qualitative information by techniques based on direct mass spectrometric as high resolution mass spectrometry with Electrospray ionization (ESI), Atmospheric Pressure Chemical Ionization (APCI), Atmospheric Pressure Photoionization (APPI), Matrix-assisted Laser Desorption Ionization (MALDI), Desorption Electrospray Ionization (DESIR) and Direct Analysis Real-Time (DART). These studies have been carried out using as a representative polymer the polystyrene (PS), which is one of the most frequently used for plastics production. Finally, LC-APPI-HRMS complemented by other techniques such as TGA, DSC and FT-IR allow obtaining qualitative and quantitative information about the whole spectrum of polymers, which may be present in the environment.

157 Uptake, egestion and accumulation of microplastic in mussel after an experimental exposure B. Fernández, Instituto Español de Oceanografía / Marine Pollution and Biological Effects Department; M. Albertos, Instituto Español de Oceanografía / Marine Environment and Environmental Protection Area. Fisiology and Ecotoxicology of Bivalve Molluscs Department

Filter feeding invertebrates such as mussels are especially susceptible target species to microplastic (MP) ingestion. Field and laboratory studies have reported that MP are ingested by mussel. Once ingested, MP may be egested through defecation, New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment

155 Atmospheric Microplastic's: A novel method for the identification of microplastic's in the inhalable size range. Using temperature dependencies for the relevant biological and toxicological processes, this modelling approach allows a more realistic risk assessment of pesticides for populations in the field.
retained in the digestive system, and/or transferred through the haemolymph to other body tissues (translocation). However, the knowledge on the ingestion and egestion of MP and on the accumulation of MP within different organs of mussel is limited. In this context, a laboratory experiment was conducted to investigate the kinetic of uptake and egestion of MP and its accumulation in digestive gland of mussel. To this end, individual mussels, Mytilus galloprovincialis, were exposed in a volume close to two nominal concentrations (2 and 4 mm$^{-1}$). Low and High MP dose, respectively) of microalgae (MA) (Isochrysis galbana) and one t-ISO) and MP (high-density polyethylene, HDPE) of similar size (Results showed no differences between the uptake kinetic of MP and MA, indicating a similar capture efficiency and acceptability for both types of particles by mussel. After 120 hours of the exposure, mussels had ingested around 80% of the MP ingested. The highest volume of MP collected after 24 hours of exposure was 1% and 2% of the MP ingested were collected after 24 hours of the exposure. Then, lower volume of MP was recorded in faeces collected after 48 hours (around 20%) and 120 hours (8%) of the exposure. The diameter of the MP particles egested decreased with time. The highest particle diameter (about 9 µm) was observed in the MP egested after 4 hours of the exposure. This may be related to a size-dependent rejection of larger MP particles in the faeces. Results showed that after 120 hours of the exposure the 6% and 2% of the MP ingested was accumulated in the digestive gland of mussels exposed to the Low and High MP dose, respectively. The diameter of this MP (around 3 µm) was significantly lower than that of the MP offered (8 µm) and the MP egested (6-9 µm). This suggested a specific removal through faeces of larger MP particles and the retention of smaller ones in the digestive system.

158 Analysis of tire wear particles in environmental samples using TED-GC-MS P. Eisenbraut, Bundesanstalt für Materialforschung und -prüfung; E. Dümichen, Bundesanstalt für Materialforschung und -prüfung / 5.3 Mechanics of Polymers; A.S. Ruhl, TU Berlin / Department of Water Quality Control; M. Jekel, TU Berlin; M. Albrecht, TU Chemnitz; U. Braun, BAM; Federal Institute for Materials Research and Testing / 5.3 Mechanics of Polymers

Tire and road wear particles (TRWP) as environmental contaminants have received interest since the 1960s[1]. TRWP have adverse effects on human health[2]. Multiple cities in the EU are violating legal threshold values for atmospheric pollution to which TRWP contribute. Therefore, financial penalties as well as consequences like vehicle bans in metropolitan regions are discussed. TRWP can reach the microplastics emissions to the environment can reach up to 60%[3]. The topic of this presentation is the occurrence and accumulation of plastic debris is a global environmental issue, with potential consequences affecting the economy, wildlife and human health. However, there is currently a lack of consensus on the definition and categorisation of environmental plastic debris, including macro-, micro- and nanoplastics. The lack of clarity in terminology regarding plastic debris, in particular microplastics, results in confusion and misunderstandings. This is problematic both for legislative measures as well as for general coherence and data comparability between studies.

While including a common language is desirable, any definition should be well-justified as it will ultimately shape the direction of future research and legislation. To help decide whether a consensus definition and categorization framework for plastic debris is valuable and if so how this might look, the scientific community needs to engage in a critical discussion. The aim of our presentation is to foster such discourse in the SETAC community by providing impulses and sharing our thoughts rather than providing definitive answers. In our presentation, we will use a new format with two presenters jointly discussing the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant components of a definition/categorization framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience throughout the presentation. This will cover opinions on the need of a definition, acceptance of certain criteria, and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea on where consensus may be easy to achieve and areas which are controversial. Finally, we will present an online platform (www.microplastics.eu, currently under development) that we will use to perform a large-scale survey on a consensus definition of environmental plastic debris. In addition, the platform will host a module for discussing the questions mentioned above and a module for networking. This platform can be used by the audience and the wider community to further discuss the impulses we give and share their opinions and input.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (II)

160 Are we speaking the same language? Towards a definition and categorization framework for environmental plastic debris M. Wagner, Norwegian University of Science and Technology / Department of Biology; N.B. Hartmann, Technical University of Denmark / DTU Environment; A. Verschueren, BAM / Centre for Safety of Substances and Products; T. Hiffer, University of Vienna / Department of Environmental Geosciences; M. Hasselöv, University of Gothenburg / Department of Marine Sciences; R.C. Thompson, Plymouth University / School of Marine Science and Engineering

The occurrence and accumulation of plastic debris is a global environmental issue, with potential consequences affecting the economy, wildlife and human health. However, there is currently a lack of consensus on the definition and categorisation of environmental plastic debris, including macro-, micro- and nanoplastics. The lack of clarity in terminology regarding plastic debris, in particular microplastics, results in confusion and misunderstandings. This is problematic both for legislative measures as well as for general coherence and data comparability between studies. While including a common language is desirable, any definition should be well-justified as it will ultimately shape the direction of future research and legislation. To help decide whether a consensus definition and categorization framework for plastic debris is valuable and if so how this might look, the scientific community needs to engage in a critical discussion. The aim of our presentation is to foster such discourse in the SETAC community by providing impulses and sharing our thoughts rather than providing definitive answers. In our presentation, we will use a new format with two presenters jointly discussing the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant components of a definition/categorization framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience throughout the presentation. This will cover opinions on the need of a definition, acceptance of certain criteria, and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea on where consensus may be easy to achieve and areas which are controversial. Finally, we will present an online platform (www.microplastics.eu, currently under development) that we will use to perform a large-scale survey on a consensus definition of environmental plastic debris. In addition, the platform will host a module for discussing the questions mentioned above and a module for networking. This platform can be used by the audience and the wider community to further discuss the impulses we give and share their opinions and input.

Behavioral and physiological responses of bicolor damselfish and mahi-mahi to olfactory cues following crude oil exposure L. Schuler, RSMAS, University of Miami / Marine Biology and Ecology; M.J. Welch, James Cook University; RSMAS University of Miami; J.D. Stiegitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; P.L. Munday, James Cook University; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology

In fishes, olfactory cues provide information about predators, prey, and conspecifics. While crude oil is toxic to many fish species, however, olfactory sensory neurons are directly exposed to the environment and are susceptible to damage from aquatic contaminants. The 2010 Gulf of Mexico oil spill overlapped with the habitat of the quantification of tire wear particles in environmental samples are still under development and struggle with multiple sources or insufficient stability of markers. We developed an analytical method which allows quantifying tire wear particles in road runoff, sediments and surface waters. Tire wear particle quantification is based on elemental composition and distinct elemental ratios. The analytical method aims at (i) tire wear particle enrichment using density separation followed by (ii) a preconcentration procedure and elemental detection with ICP-OES/SF. The quantification is based on sulphur and carbon. A stepwise method development including analytical methods and verification by determination of the rubber content is presented. In particular, S and Zn are present in characteristic concentrations in tires. Zn and S contents were determined in 30 tire samples as an internal reference. The average S content in the analysed tires was 15400 mg/kg (± 6000 SD), while the average Zn concentration was 500 mg/kg (± 170 mg/kg) difference (± 9 SD). Furthermore, the developed method was applied to field samples. Samples were taken from the intake water of a treatment facility (raw water), from the sedimentation basin, the inlet of the soil retention filter as well as from the soil itself. Isolation of tire wear particles by density separation was achieved by use of a heavy liquid, sodium polytungstate mixed with MilliQ water. Separated fractions were acid digested with microwave assistance and elemental analysis was conducted by ICP-MS and ICP-OES. Elemental content of the particulate fraction in the water samples was analysed after filtration only, since the amount of solids was too low for the density separation procedure. Acknowledgement - The authors thank the BMBF for funding the MiWa project (reference number 02W01378H) and BBW for provision of samples.
pelagic and reef fishes, including mahi-mahi (Coryphaena hippurus) and bicolour damselfish (Stegastes partitus). To date, within the marine teleost group, nothing is known about how crude oil exposure affects the detection of olfactory cues or if crude oil can be detected and avoided. To address these questions, the time that control and oil-exposed bicolour damselfish spent in a chemical alarm cue and the time that control and oil-exposed mahi-mahi spent in diluted crude oil was examined using a two channel flameécoute system. Exposed mahi-mahi displayed avoidance of a chemospecific chemical alarm cue, whereas exposed conspecifics did not avoid the cue (p < 0.001). Control mahi-mahi did not distinguish between seawater and crude oil, however oil exposed mahi-mahi spent a greater proportion of time in crude oil than the control fish (p < 0.01). Moving forward, an electro-olfactogram technique will be used to measure the generator potential from the olfactory epithelium of bicolour damselfish and mahi-mahi to detect the response to olfactory cues following oil exposure. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

162 A wide range of endpoints are impacted by oil exposure in early and later life stages of marine fish

M. Grosell, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; R.M. Heuer, University of Miami / Marine Biology and Ecology; C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L. Schreiber, RST, OAS; Exposed fish. Such reductions in cardiomyocyte contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

163 Investigating the endocrine disruptive and genotoxic potential of crude oil samples using adapted in vitro toxicity tests

S. Johann, Institute for Environmental Research RWTH Aachen University; L. Nuesser, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; L. Spencer, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; D. Altin, BioTris; H. Hollert, RWTH Aachen University / Institute for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis

In case of an acute oil spill the decision on optimal response techniques to achieve the best environmental benefit is based on important knowledge about regional ecosystem function. Even adult marine fish are sensitive to low-level oil exposures, showing reduced acrobics scope and swim performance. The lower swim performance in adult oil-exposed fish with a normally developed heart, is due to reduced cardiac output driven by reduced stroke volume. Work on isolated cardiomyocytes show that sarcomere shortening upon electrical stimulation is reduced by acute oil exposure which likely explains the reduced stroke volume observed in adult fish. Such reductions in cardiomyocyte contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

164 Impacts of Oil Exposure on Mahi Embryos

C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L.E. Sweet, Environmental Protection Agency USA; E.M. Mager, University of North Texas / Department of Biological Sciences; J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; A.P. Roberts, University of North Texas / Department of Biology Institute of Applied Science; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology.

The Deepwater Horizon spill coincided with the spawning window of many ecologically and economically important fish species, such as mahi-mahi (Coryphaena hippurus). Aside from the acute mortality elicited by this event, additional sublethal effects may have imparted more subtle yet ecologically significant consequences on populations of pelagic fishes as a whole. The maintenance of embryo buoyancy is critical to survival, and aids in promoting dispersal by facilitating drift through ocean currents and positioning newly hatched larvae in the upper water columns where planktonic food is plentiful. We found that co-exposure to oil and additional environmentally relevant stressors, such as high temperature and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Further, reduced negative buoyancy was coupled with significantly faster sinking rates and increased energy depletion, likely resulting in detrimental consequences for these developing fish. The mechanisms behind untimely buoyancy change are unknown, but our findings suggest a behavioral avoidance response as well as an inability to maintain buoyancy due to diminished energy reserves. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

165 Crude oil impairs heart cell function in the pelagic mahi-mahi (Coryphaena hippurus)

R.M. Heuer, University of Miami / Marine Biology and Ecology; H.A. Shiels, G.L. Galli, University of Manchester / Faculty of Biology, Medicine and Health Sciences; G.K. Cox, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology; D.A. Crossley, University of North Texas / Department of Biological Sciences

Crude oil from the Deepwater Horizon spill of 2010 has been shown to have a number of cardiovascular effects across life stages, species, and levels of organization in marine fish. Over the last decade, the use of the mahi-mahi (Coryphaena hippurus) to study these cardiovascular impairments has been particularly important, since this pelagic species is both ecologically and economically important in the Gulf of Mexico. Mahi exposed to environmentally-relevant crude oil concentrations have shown compromised intact animal performance, including reductions to maximal swimming speed and maximal metabolic rate. In addition, in-situ studies have revealed a 40% reduction in cardiac output following oil exposure in mahi. Although cardioactive effects have been widely reported, the mechanisms underlying these effects remain unknown. In this present study, we examined the impacts of crude oil on isolated mahi heart cells to better understand these mechanisms. Contractility of mahi ventricular heart cells was measured via sarcomere shortening using an IonOptix cell recording system. The first objective was to examine cardiomyocyte contractility over range of crude oil exposures. The second objective was to examine the impacts of crude oil contractility over a range of stimulation frequencies representative of heart rates observed in mahi (~100-180 beats per minute). Exposure to crude oil was found to significantly reduce heart cell contractile function, but was not found to be dose-dependent in the tested range of concentrations (3.0, 6.4, and 12.9 μg l^-1 ∑50 PAH). Exposure to crude oil was also found to impair contractility over a range of stimulation frequencies (1.5, 2.0, 2.5, 2.5, 3.0 Hz; 3.6 μg l^-1 ∑50 PAH). In addition to contractility, other mechanical aspects of cell contractile function were also examined. Efforts to assess the role of circulating catecholamines (adrenaline) as a potential protective mechanism against these impairments is currently ongoing and will also be presented. This research was made possible by a grant from The Gulf of Mexico Research Initiative Award SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).
microRNA and messenger RNA networks in early life stages of pelagic and nearshore fish species exposed to Deepwater Horizon oil

D. Schlenk, University of California-Riverside / Department of Environmental Sciences and Engineering; G. Xu, UC Riverside / Department of Environmental Sciences Developmental cardiotoxicity is a commonly observed phenotype in a number of fish species following exposure Polyaromatic hydrocarbon (PAH) or oil. While many PAHs elicit cardiotoxicity through activation of the aryl hydrocarbon receptor (AhR). Additional pathways of toxicity have been observed including downregulation of genes that regulate potassium and calcium channels in embryonic and larval fish of development. While functional inhibition the channels has been observed following exposure to oil and non-AhR activating PAHs, mechanisms associated with downregulation has not been observed. MicroRNAs (miRNA) play key roles in a number of diverse biological processes including heart development in vertebrates. To test the hypothesis whether miRNA changes may regulate ion channel genes, embryos and larvae of mahi-mahi (Coryphaena hippurus) were treated with High Energy Water Accommodated Fractions (HEWAF) made from source and weathered DHW oil. miRNAs and mRNA were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target miRNAs was consistent with pathway analysis of miRNAs, predicting disruption of cardiovascular system development after oil exposure and showed that specific miRNA–mRNA interactions may contribute to these effects (Figure 1). Oil caused an overexpression of miR-133a, miR-34, and miR-15b (Figure 2). Enhanced expression of miR-133a correlated to the decrease in the expression of KCNH2 mRNA, which controls the potassium ion transporter that has been observed to be reduced in the cardiac phenotype in multiple fish species following oil treatment. In addition miR-34 and miR-15b were also upregulated and informative analyses with miRNAs were consistent impairment of eye development (Figure 2). Ongoing analyses of dose response treatments at early hatch larval stages (48 hpf) will provide additional data that will enhance our knowledge of the impacts of oil on fish development. This research was made possible by a grant from the Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER). Alternative Approaches to Animal Testing for Ecotoxicity Assessments

Early life stages of a vertebrate species as an alternative model for the study of stressors in marine environment

M.J. Aranjo, CESAM & DeBio / APPLEE; R.J. Rocha, Department of Biology & CESAM – University of Aveiro / Department of Biology and CESAM; C. Quintaneiro, Department of Biology & CESAM - University of Aveiro; A.M. Serrador, University of Aveiro / Department of Biology & CESAM; M. Monteiro, Aveiro University / Biology Early life stages of marine vertebrates have been scarcely used in ecotoxicity testing. The Senegalese sole (Solea senegalensis Kaup, 1858) is a common vertebrate occurring in Eastern Atlantic coastal areas. Eggs of this marine vertebrate can be obtained from aquaculture rearing facilities and used in laboratory as testing organisms. At the end of the first month of life this species completes a metamorphosis, changing from bilateral to flatten shape morphology. Early life stages of aquatic vertebrates are windows of development considered highly sensitive to anthropogenic contamination, including in marine environment. Organic compounds, such as pesticides and personal care products have been increasingly used and directly released to the aquatic ecosystems or indirectly released from wastewater treatment plants. Besides, human activities have been increasingly used and directly released to the aquatic ecosystems or indirectly released from wastewater treatment plants. In this work we aim to understand the effects of different stressors to early life stages of S. senegalensis, namely of UV radiation and of the organic compounds 4MBC, Carbendazim, Linuron and Triclosan, which have potential endocrine disruptor properties. High-throughput analysis using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target mRNAs was consistent impairment of eye development. High-throughput analysis using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target mRNAs was consistent impairment of heart development, growth, behaviour and biochemical markers were evaluated as endpoints in two periods of exposure to stressors: a first initial period between egg stage and 96 hpf and a second period during the nearly 15-15 day full metamorphosis progression of S. senegalensis. Exposure to UV radiation and to the four organic compounds (compounds 4MBC, Carbendazim, Linuron and Triclosan) was performed. Our results strongly suggest a role for S. senegalensis embryos and larvae during early life stages testing requires the evaluation of effects at different developmental stages. Initial egg stages globally display a higher sensitivity to stressors, presenting lower LC50 and EC50 values. Besides, biochemical markers (cholinesterases and oxidative stress) were differently affected, depending on S. senegalensis life stage. Significant alterations of normal behavioural pattern were observed in response to stressors exposure, confirming behaviour as a sensitive and relevant tool in ecotoxicology studies. The increasing environmental levels of the contaminants tested may lead to adverse effects on highly sensitive life stages of marine vertebrate species.

Predicting in vivo toxicity from in vitro transcriptional responses following chemical exposure

D. Basili, University of Liverpool / Institute of Integrative Biology; M. Knoteb, Eawag / UTOX; A. Sawle, Cancer Research UK Cambridge Institute / Department System Biology; L. Huijberts, P. Aerts, University of Liverpool / Institute of Integrative Biology; K. Schirmer, Eawag / University of Integrative Toxicology; A. Cossins, F. Falciani, University of Liverpool / Institute of Integrative Biology Alternatives to in vivo animal testing in ecotoxicology aim to increase the throughput of chemical safety assessment whilst reducing the number of animals used. The use of in vitro systems is more cost-effective, practical and expedient. However, it is still unclear whether current in vitro methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line ( Oncorhynchus mykiss, RTgill-w1) exposed to a given chemical can be used as a biosensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that gill cell line has the potential to replace zebrafish embryo in toxicity testing Combining computational modelling with in-vitro cellular responses in order to predict chemical impact on fish growth

K. Schirmer, Eawag / Environmental Toxicology; H. Mottaz, R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Stadnicka-Michalak, EPFL Swiss Federal Institute of Technology / Environmental Toxicology A paradigm shift in chemical risk assessment is needed due to the time-consumption and ethical controversies of current chemical testing on animals. However, in spite of several promising methods and computational tools, the in vitro approach is still flawed. In this project, we propose that the chemical effects on cell population growth, measured over few days, can be used as proxy for chemical impact on fish growth, which needs weeks to occur. In particular, we linked information on the proliferation and survival of a fish gill cell line (in vitro) to the effect of chemicals on fish growth (in vivo). Research was divided into two phases. In the first phase, we have tested in vitro several chemical concentrations that correspond to those used in in vivo test procedures. In the second phase, we used a computational approach so that no prior knowledge about chemical concentrations tested in vivo was required: in vivo data were needed only to validate the model but not to decide which chemical concentrations should be tested in vitro. More than ten organic chemicals (including fungicides, herbicides, insecticides, industrial compounds and pharmaceuticals) were tested for different fish species (rainbow trout, fathead minnow and zebrafish). The results indicate a very good agreement between measurements and predictions determined for different species of fish, being exposed in vivo from 7 to 62 days, depending on the species and test design. Results moreover confirm that it is possible to predict chemical impact on fish growth without prior knowledge on concentrations that are used in in vivo studies for chemicals that do cause an effect on fish weight as well as for those that do not. Therefore, in spite of several methodological and computational tools, combining in vitro experiments with computational modelling can result in a powerful strategy for screening chemicals to determine their effects on fish. In addition, considering the simplicity, rapidity and low costs of this approach, we believe that it can be an encouraging step toward alternatives to long-term whole organism toxicity testing. Ecological Threshold for Toxicological Concern (eco-TTC) - Applications for Environmental Risk Assessment in Various Contexts

M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; S.E. Belenger, The Proctor & Gamble Company / Environmental Stewardship and Sustainability Organization; M.A. Bonnell, Environment and Climate Change Canada / Ecological Assessment Division; D.T. Chang, United States Environmental Protection Agency / National Exposure Research Laboratory; K.A. Connors, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; D. De Zwart, DDZ Ecotoxicology Centre for Sustainability Evaluation; E. Echizen, ILSI Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; S.A. Hughes, Shell Health - Americas / Shell Health Risk Science Team; A. Kienzler, European Commission - Joint Research Centre / DG Joint Research Centre IHCPC EURL ECVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; R.R. Otter, Middle Tennessee State University / Biology; H. Sanderson, Aarhus University; P. Wilson, SANOFI The Threshold for Toxicological Concern (TTC) is well-established for assessing human safety but has only recently been explored in the ecological context. Ecological Thresholds for Toxicological Concern TTC (eco-TTC) summarize the
wealth of ecotoxicological information as Predicted No-Obversed Effect Concentrations (PNECs) on diverse chemical substances in the form of probability distributions. These enable the prediction of untested chemicals based on a structural attribute, mode of action, or functional use. The approach may be useful for assessing chemicals at early tiers of the risk assessment process, providing hazard perspective on chemicals that lack QSARs, guiding product development discussions, and assisting read across or category justifications. An ecotoxicological database of approximately 120,000 records was developed based on recent assessments of published data and international chemical management programs. This ecotoxicity data is associated with physical chemistry data and curated taxonomic information for the organisms tested, including a process to conclude acute and chronic effects as well as identify the PNEC for exposed ecosystems based on depth and breadth of data. Several modes of action schemes are included to facilitate development of a best approach for grouping compounds. To make these data accessible and useful to stakeholders, the dataset was transitioned from Microsoft Excel and Access into a modern MySQL format, allowing for a format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. The dataset is accessed via a web-based query system that is integrated with PNEC calculator and probability distribution tools. The novel interface allows users to explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecoTTC concept. An international workshop was held to discuss and evaluate the feasibility of the eco-TTC approach, which included evaluation of several case-studies based on particular decision-contexts (e.g., prioritization of screening chemical risk MoAs. In specific risk assessment, mixtures, product development, criteria development). This presentation will highlight the discussions and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

171 Mode of action diagnosis by normalized multiple endpoint assessment in zebrafish embryos

E. Teixido, Helmholtz Center for Environmental Research - UFZ GmbH / Department Bioanalytical Ecotoxicology; N. Klüver, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; O. Kerkhof, Helmholtz centre for environmental research - UFZ / Department Bioanalytical Ecotoxicology; M. Leonard, IOREAL SA; T. Kießling, Scientific Software Solutions; R. Altenburger, UFZ Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; M. Taggart, University of the Highlands and Islands / Environmental Research Institute

The diagnosis of a specific or reactive mode of action (MoA) is crucial for the prediction of adverse effects using alternative test systems. While baseline toxicity can be easily predicted using regression-based QSARs, the identification of non-baseline toxicants requires assessment of endpoints that can be related to the MoA of a chemical and ultimately assign an adverse outcome pathway. Such a MoA analysis could be possible using the zebrafish embryo test (ZPET) extended by various endpoints, including chemical risk MoAs. In specific risk assessment systems, the detection of MoA-related endpoints has been discussed to improve its predictive capacity for acute and chronic fish toxicity, and for human developmental toxicity. We hypothesized that using a battery of endpoints in the zebrafish embryo test would allow to differentiate between baseline toxicity, formation of methemoglobin, neurotoxicity, heart rate inhibition, and developmental toxicity. Therefore, we compared the toxic ratios and endpoint-specific effect concentrations (EC50) of 12 compounds representing 5 broad MoA groups with 2, respectively 4 (neurotoxicity) compounds per MoA. In order to compensate for differences in the toxicokinetics and mortality, the effect concentrations were normalized by the LC50 of each compound. It was shown that the toxic ratio and effect concentrations for behavior, heart rate inhibition and chorda malformations were able to differentiate the selected compounds according to their anticipated MoA. Using a threshold for the normalized effect concentration a decision tree was developed that allowed to assign a MoA to a compound. A major bias of the selected approach could be the variability associated with visual endpoint assessment, which may depend on the experience and accuracy of the observer. Therefore, we introduced into ecosystems and since these substances are intended to have effects on “crop pests” and side effects on non-target species cannot be fully avoided. However, doing so, we often ignore the context, the reasons why crop protection products are utilized. This ignorance can lead to failing the overall targets or lead to sub-optimal or even wrong decisions. This will be explained in more detail in the following presentation advocating for a more holistic approach in environmental risk assessment. Agriculture per se does have an impact on the environment and chemical products. This ignorance can lead to failing the overall targets or lead to sub-optimal or even wrong decisions. This will be explained in more detail in the following presentation advocating for a more holistic approach in environmental risk assessment. Agriculture per se does have an impact on the environment and chemical products.
does reduce biodiversity at the sites used for food production. This, in principle, is true for any kind of agriculture. As a consequence, it is irrational to demand that agriculture, respectively the different agricultural practices, shall have ‘no impact’ on the environment. Accordingly, regulations require that ‘no unacceptable’ impact may occur. To define what constitutes an acceptable impact and what not, the ‘Ecosystem Services’ concept is considered a suitable approach. This is not a call for ignoring the impact of crop protection products. However, for achieving our targets and maintaining sufficient local food production and an environmental impact we need to have a broader approach and evaluate the cost/benefits of all agricultural tools equally against the background of food produced per area. Scientific tools to go for such more complex holistic approaches are partly available, but more efforts are needed to develop practical and manageable concepts allowing an assessment in the crudest possible level. In addition, the regulatory options have to be broadened from mere risk assessment of chemicals towards a landscape level assessment of food production, and risk management has to include landscape management options. Ecotoxicological research is undoubtedly important; however, in order to achieve the overall target of feeding human populations in a sustainable way and maintaining ecosystem health, we need to cover all aspects of “stress ecology” (impacts of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

183 Identifying ecosystem services-based protection goals.

L. Malby, Y. Pan, The University of Sheffield / Dpt of Animal Plant Sciences

There is an increasing interest in the use of ecosystem service-based approaches for assessing the risk of environmental contaminants to ecological systems. Ecosystem functions become ecosystem services when they are utilized and valued by people. Therefore, the first step in implementing an ecosystem service approach to ecological risk assessment is to identify what services of pesticides are required, by whom and where they should be protected. But to have preferences such as these, we need to cover all aspects of “stress ecology” (impacts of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

184 ECPA over-arching Specific Protection Goals proposal for EFSA Non-Target Terrestrial Plants, Non-Target Arthropods and Soil Organisms Guidance Documents based on EFSA Ecosystem Services approach

K. Romijn, Bayer CropScience AG

Currently there are 3 Scientific Opinions from EFSA that are waiting to be developed into Guidance Documents ie Effects of pesticides on Non Target Terrestrial Plants, Non Target Arthropods and Soil Organisms. Whilst each of these Scientific Opinions makes proposals for SPGs, the European Commission and Member States should agree on the on SPGs before they can be taken forward to be used in the Guidance Document development phase. The purpose of this paper is to provide industry input for consideration and discussion during this process. In an earlier EFSA Scientific Opinion it was recommended by EFSA that Specific Protection Goals (SPGs) should be based on the principle of Ecosystem Services utilising 6 dimensions: ie biological entity, attribute, magnitude, temporal and geographical scale of the effect, and the degree of certainty that the specified level of effect will not be exceeded. Whilst this EFSA Scientific Opinion is a good basis for setting SPGs going forward, the experience with the EFSA Bee Guidance Document shows there is a need to reconsider how the principles described in this EFSA SPG Opinion are applied to SPG setting in individual Guidance Documents. In the case of the EFSA Bee Guidance SPG it was not the definition of “negligible effects” on colony strength that was the controversial issue but the translation of this into a numerical value (≤ 7%) without robust scientific justification. The use of 7% suggested there was data to support it but in fact it was still a judgment, i.e. it is a hidden ‘judgement’. The suggestion that the impacts of a herbicide can be related on a logistic scale between large (≥35%), medium (15-35%) small (7-15%) and negligible (3.5-7.5%) is in itself surprising for a biological system particularly one with complex feedback loops such as in honeybee colonies. To avoid the difficulty of selecting a specific hard numerical SPG value upon which consensus between different scientist and stakeholders is required, it is recommended to use an empirical judgement qualitative approach adapting the EFSA Ecosystem Services approach. The predicted impact of any effect of a PPP on an invertebrate/plant population should be described using expert judgement, which combines the predictions of all 4 EFSA dimensions above (attribute/nature of effect, magnitude, temporal and spatial scales of effects) as well as the number and importance (eg, key species) of species potentially affected, and the frequency of occurrence.

185 Protection goals for non-target terrestrial plants: Is in-field protection of beneficial weeds achievable?

J. Davies, Syngenta / Environmental Safety; L. May, A. Russell, A. Seville, D. Stock, Syngenta

EFSA’s Scientific Opinion addressed the question on the science of the risk assessment of plant protection products for non-target terrestrial plants (NTPPs) was published in 2014. The Opinion defines non-target plants as all plants growing outside fields and those growing within fields that are not the intended pesticide target. It also states that non-crop plants growing in in-field areas provide ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, The Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weeds, as well as those growing in the crop canopy, for their non-target value. In addition, the regulatory options have to be broadened from mere risk assessment of chemicals towards a landscape level assessment of food production, and risk management has to include landscape management options. Ecotoxicological research is undoubtedly important; however, in order to achieve the overall target of feeding human populations in a sustainable way and maintaining ecosystem health, we need to cover all aspects of “stress ecology” (impacts of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

186 Specific Protection Goals and the Assessment of Key Drivers in the Aquatic Environment: Are we doing the right thing?

R. Benstead, Fera Science Ltd. / Centre for Chemical Safety and Stewardship; D. Phillips, Fera Science Ltd / Environmental Sciences; P. Gilbertson, Fera Science Ltd; J. Clain, Centre for Crop Health and Protection (CHAP)

When designing High Tier Assessments, the underlying concept is a progression from simple and conservative laboratory exposures, towards those that more closely resemble the ‘Final Reference’ (the actual ecosystem), so that the risk assessment can be refined by reducing the Assessment Factor that accounts for uncertainty. In the aquatic environment, the focus of High Tier Assessments should not be the Direct Protection Goal, but be the Specific Protection Goals as defined for surface waters; Biodiversity and Ecosystem Services. Biodiversity is a common and important General Protection Goal, and Ecosystem Services, as they pertain to human health and welfare, are comprised of ‘provisioning services’ (e.g. drinking water), ‘regulating services’ (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape that conserve species and promote well being). To this aim, EFSA Guidance requires that a surrogate system for the Final Reference (termed the Surrogate Reference Tier) scientifically underpins the assumption that the endpoints assessed at High Tier are closer to the actual objectives of the adopted protection goal. It is accepted that Low Tier assessments do not measure the SPG directly, and therefore at High Tier, endpoint assessment should rely on ecotoxicological and protecstological data that are more directly relatable to the ‘target image’ of the aquatic community. This surrogate system should be relevant for the surface water at risk, and endpoints should account for the ecological traits of the important aquatic species at risk. The EFSA PPR Panel’s solution was to identify for each Key Driver (taxonomic group or other ecological entity), a Surrogate Reference Tier that is based on the most sophisticated experimental or modelling risk assessment currently available to address the SPG. Consequently, scientists should ensure that Aquatic High Tier experimental approaches are (a) the most sophisticated approach available and (b) represent the ‘target image’ of the biodiverse aquatic communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment endpoints are those that reflect both functional and trait-based effects, and those that preserve the biodiversity of ecosystem services communities that ultimately present the ‘target image’ and therefore closer relevance to the Final Reference.

187 Is “biodiversity” a measurable study endpoint?

E.M. Bakker, Eurofins-ITC Environmental Sciences

The general protection goal addressed by current and future risk assessment schemes for Plant Protection Products is Biodiversity. In addition to this there are specific protection goals that may conflict with the general protection goal. Specific protection goals are generally phrased in terms of Ecosystem Services and expressed in human currency there is a risk that economic motives may prevail in their prioritization. After all, who is to judge e.g. whether preservation of pest control capacity outweighs the preservation of aesthetic value? Biodiversity is a concept with many facets and the quantification of biodiversity is no straightforward exercise. A vast array of indices exists (see e.g. Maguran 2004).
and not a single one would capture the essence on its own. The two basic parameters involved in biodiversity measures are the number of species and their abundance. Their correct estimation is core to biodiversity assessments and their balance describes community structure in terms of e.g. dominance, evenness and diversity. Similarity indices have been developed that enable the comparison of (sub)habitats, which seems a promising lead to assessing effects on biodiversity in experimental designs. With this contribution we explore different approaches to quantifying effects on structure and function resulting from protection products in an experimental setting. We apply and compare multivariate statistical approaches, similarity indices and a combination of univariate statistics and species richness assessments and discuss how these findings may address the general issue of effects on biodiversity.

Innovative techniques for enhancing and monitoring microbial activities for in situ remediation of contaminated sites

188 Evaluation of plant-driven biostimulation of soil microbe for the setup of a site-tailored rhizoremediation process in a historical PCB-polluted soil

L. Vergani, University of Milan / DeFENS; F. Mapelli, University of Milan-DeFENS / Department of Food, Environmental and Nutritional Sciences; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; O. Uihli, University of Chieti and Pescara; E. Zennaro, Montecatini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The Site of National Priority (SN) Brescia-Caffaro is a highly polluted area in Northern Italy presenting mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). In order to evaluate the potential of the rhizosphere of plant species for bioremediation, we applied treatments for the development of a suitable rhizoremidiation strategy, an experimental trial including ten vegetated treatments and their non-plant controls was set up for 18 months in greenhouse conditions. Molecular fingerprinting was applied to unveil the ability of different plants/soil treatments to shape the structure of soil microbial communities. The results showed a succession over time in both bacterial and fungal assemblages. Only the diversity of the bacterial community was, nevertheless, significantly and differentially influenced according to the applied treatment. The stimulation effect on the organic matter hydrolitic activity of the soil microbiota was evaluated using fluorescein diacetate as a proxy. All the vegetated treatments showed a significant increase in activity after 18 months from planting, demonstrating effective biostimulation of the soil bacterial communities, putatively enhancing their degradation capacity and, consequently, sustaining rhizoremediation. Aiming to select bacterial strains to be exploited for autochthonous bioaugmentation coupled to rhizoremediation, we established a collection of isolates from the soil biostimulated by Pseudomonas aeruginosa. These species cultivated in conditions of redox cycle showed to stimulate the highest indicated activity of biphenyl degradation (PCE, TCE and cis-DCE) throughout the 18-month biostimulated soil was incubated with 13C-labelled 4-chlorobiphenyl, the production of 13CO2 indicated metabolic activity of biphenyl and possibly the presence of PCB-degrading populations. All the isolates were identified as Actinobacteria and were characterized for PCB-degradation and plant growth promotion. In particular, three Rhodococcus sp. strains significantly promoted lateral root development in the model plant Arabidopsis thaliana and depleted PCBs from the cultivation medium according to the results of a resting-cell assay, thus representing ideal candidates to sustain PCB-rhizoremediation through a site-tailored bioaugmentation approach.

189 Enhancement of Biological Reductive Dechlorination by in situ Adsorption onto Colloidal Activated Carbon: from the Lab to the Full Scale Application

M.P. Papini, F. Arjmand, Università La Sapienza / Chemistry; P. Ciampi, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The University of Rome “La Sapienza” has been commissioned to evaluate strategies for the management of the contaminated areas of the new High Speed Railway Station of Bologna (Italy), where a historical Chlorinated Aliphatic Hydrocarbons (CAHs) contamination has been found in two aquifers and characterized by a long-term evolution. In situ monitoring campaigns (PCE, TCE and cis-DCE - concentrations ranging between 10–100 µg/L). The Italian environmental legislation is among the most restrictive in Europe with some of the most stringent target levels especially concerning the CAHs. A thorough investigation of the site has been carried out (geological, chemical and biological) and integrated with a microcosm study. Based on the results, biological reductive dechlorination was recognized as a potential approach for the site remediation but the extremely low CAHs concentration and the consequent kinetic limitation made it unfeasible for the site. Thus, the possibility to use a new dispersed colloidal activated carbon technology (Plumestop™, Regenesis) together with an electron donor to create an in-situ adsorption/biologically-reactive zone was deeply investigated and finally adopted as the site-specific remediation approach. The full-scale remediation plan was approved by the local authorities and completed by the end of 2016. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after more than one year appear particularly encouraging. A significant reduction of the CAHs concentrations was observed in all the treated zones. Together with classical chemical analyses, microbiological tools, such as qPCR and CARD-FISH, were used to verify the enhancement of the biological reductive activities induced by the simultaneous injection of activated carbon and electron donor.

190 An innovative bioelectrochemical reactor for in-situ treatment of groundwater contaminated by monoaromatic petroleum hydrocarbons

E. Palma, CNR-IRSA; M. Daghio, A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences; M.P. Papini, Università La Sapienza / Chemistry; E. Aulenta, National Research Council / Water Research Institute (IRSA)

A major share of world energy production, derives from fossil fuels, such as oil. According to OPEC (Organization of the Petroleum Exporting Countries), world oil demand growth is expected to rise by 1.53 mb/d in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a result of industrial accidents, spills, or accidents. Groundwater contamination by petroleum hydrocarbon is a serious problem, with nearly 50% of groundwater contamination being due to petroleum-deriving products such as mineral oil, chlorinated hydrocarbons, monoaromatics (e.g., BTEX) and poly cyclic aromatic hydrocarbons (i.e., PAH). Accidental petroleum spills may result in severe environmental problems, hence requiring the development and implementation of suitable remediation strategies. In recent years, microbial electrochemical technologies (MET) have attracted considerable attention as an effective and sustainable remediation technique. In MET the microorganisms catalyze oxidation or reduction reactions by using solid-state electrodes as terminal electron acceptors or donors. The discovery that carbon-based electrodes can be used as terminal electron acceptors in the anaerobic oxidation of a variety of organic substrates has raised the possibility that they could be employed in-situ to accelerate the anaerobic oxidation of environmental contaminants, such as petroleum hydrocarbons in soils and groundwater. Here we describe a novel bioelectrochemical reactor configuration, named the “bioelectrochemical well”, that is suitable for in-situ treatment of contaminated groundwater. A lab-scale prototype of the bioremediation (“bioelectrochemical well [1]”) has been realized and operated in a continuous-flow regime using first toluene and then a mixture of BTEX as model contaminants. The performance of the bioelectrochemical reactor was characterized in terms of degradation rate and yield. GC-MS analysis was also carried out in order to shed light on the “electrogenic” pathway of contaminants biodegradation. This study was financially supported by Fondazione Cariplo in the framework of the project B-E/ERAGE - BioELECTrochemical Remediation of Groundwater plumes (2015-0195), [1] Palma E., Daghio M., Franzetti A., Petrangeli Papini M., Aulenta F. The bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. MicroBiotechnol., 2017. doi: 10.1111/1751-7915.12760.

191 Identification of major HMW-PAH degrading communities during active bioremediation of a PAH-contaminated groundwater

J. Vila, Instituto de Recursos Naturales y Agrobiologia; M. Grifoll, Universitat de Barcelona / Dept. Genetica, Microbiologia i Estadistica; M. Aitken, University of North Carolina / Environmental Sciences and Engineering; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica y Conservacion del Suelo

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) in soils is generally constrained by their low availability to microbial communities. As a result, a range of unplateful bioremediation applications of PAHs in soils, e.g. consecutive biostimulation coupled to rhizoremediation, with a major composition in high molecular weight (HMW) compounds (four or more rings). We analyzed the active microbial processes associated with the dissipation of PAHs during a lab-scale bioremediation of a creosote-contaminated soil. Treatment under stimulated conditions resulted in an extensive reduction (93%) of the total PAH concentration. Low molecular weight (LMW) compounds (2 rings or 5 rings) were mostly depleted during the first month of incubation. In contrast, degradation of HMW-PAHs started thereafter following biphasic kinetics. Despite the 16s rDNA gene copy numbers (bacterial abundance) remained constant throughout the 5-month treatment period, the number of 16s rDNA gene transcripts (bacterial activity) dramatically increased (from 10^7 to 10^9 copies/g dry soil) during the initial 45 days, associated with major PAH removal. Further experiments were designed to determine the specific microbial communities that were involved with the transformation of HMW-PAHs. The project BE/ERAGE - BioELECTrochemical Remediation of Groundwater plumes (2015-0195). [1] Palma E., Daghio M., Franzetti A., Petrangeli Papini M., Aulenta F. The bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. MicroBiotechnol., 2017. doi: 10.1111/1751-7915.12760.
Gram-positive bacteria, associated to Mycobacterium, were mainly active during the last two months of incubation, when only residual fractions of HMW compounds were degraded. Community analysis during the period of major HMW-PAH removal identified members of the recently described order Immunodissolobacterales and members of Sphingobium as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of Immunodissolobacterales major phylotypes were assigned to the immigration, which are members of Immunodissolobacterales clearly predominated in incubations with 13C-tyramine and 13C-benzo[a]anthracene. Interestingly, members of Mycobacterium, traditionally associated to HMW-PAH degradation were not detected in either of the incubations. Our results indicate the minor contribution of contaminated to the degradation of the more labile fraction of HMW-PAHs. Their increased activity during the late incubation phase when degradation kinetics were drastically attenuated, suggested their potential action on the residual fraction of contaminant.

192 Stable Isotope Raman Microspectroscopy and Surface-Enhanced Raman Scattering: Analysis of Microorganisms at Single Cell Level
N.P. Ivleva, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; R. Weiss, M. Seidel, Technical University of Munich; R. Nissen, Technische Universität München / Chemistry Department, Chair of Analytical and Water Chemistry; M. Elsner, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry

This work was carried out for the German Federal Environment Agency (UBA) in Munich as part of the EU COST Action BM1103 "Living with Chemicals in the European Environment: A sustainable approach to chemical management in a globalized world". We thank the COST BM1103 Action Committee and the UBA for their support.

The authors declare no competing financial interests.

193 Flux chambers data for the estimation of the biodegradation rate in the subsurface at hydrocarbon contaminated sites
I. Verginelli, University of Rome Tor Vergata / Department of Civil Engineering and Computer Science Engineering; R. Pecoraro, Versalis; R. Baciocchi, University of Rome Tor Vergata

The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microorganisms has been described and indicated to result in elimination of petroleum hydrocarbon vapours from contaminated soil or groundwater on outdoor and indoor air quality. The occurrence of natural attenuation in the subsurface is generally evaluated by employing multi-level soil gas sampling through the installation of nested probes, by applying the so-called “gradient method”. In this way, it is possible to assess the vertical concentration profiles of vapors and oxygen above the source area, and hereby estimate the attenuation rates in terms of soil gas fluxes through the subsurface. In this work, we propose a novel approach based on the combination of the data obtained from standard source characterization with dynamic flux chambers measurements. The natural attenuation rates are calculated as difference between the flux of contaminants estimated with a non-reactive diffusive model starting from the concentrations of the contaminants detected in the source (soil and/or groundwater) and the effective emission rate of the contaminants measured using dynamic flux chambers installed at ground level. The reliability of this approach was tested in a versalis site characterized by the presence of BTEX in soil and groundwater, using dynamic flux chambers. The site is characterised by the presence in the subsurface (mainly in groundwater) of BTEX and light petroleum hydrocarbons. The flux of volatile organic compounds (VOCs) from the subsurface was estimated using 14 “dynamic” chambers, by measuring with a canister the concentration of vapours collected over a period of approximately 6 hours. Before starting the measurement, the achievement of steady-state conditions inside the chamber was assured by purging at least 4 chamber volumes with an inert gas. The measurements sampling points were repeated in 4 seasonal campaigns. The obtained results highlighted that the traditional methods based on the application of a non-reactive diffusive model with the concentrations measured in the soil and/or groundwater can lead to an overestimation of the emission rates of BTEX from the subsurface in some cases up to 4 orders of magnitude. Furthermore, the BTEX loss rates for the investigated site were found to be up to almost 0.5 kg/year/m2. These rates are in line with the values reported in the recent literature for natural source zone depletion.

New frontiers in Life Cycle Inventory data collection and modelling

194 The end of an era: is data and model exchange across LCA software tools finally possible? M. Vierea, PRe Sustainability; K. Cenian, PRe Consultants; A. de Schryver, European Commission; A. Genest, ifu Hamburg; L. Zampori, European Commission / Joint Research Centre; C. Wolf, Tier3 Solutions GmbH; M. Dupriez, RDC Environment; S. Horlacher, thinkstep; E. Mieras, PRe Sustainability

In the context of the Environmental Footprint (EF) pilot phase, the European Commission requested the development of 70 representative products/organisations (RPs/ROs) so they are consistent with the requirements of the final product environmental footprint category (PEFCRs) and organization environmental footprint sector rules (OEFSRs), they use the prescribed EF-compliant secondary datasets, and can be made available for free to any user applying a PEFCR/OEFSR and are easily usable in the major existing LCA software tools. An implicit prerequisite is that software tools give equal results when calculating the impact of the same RPs/ROs. At the start, a document was established that defined the minimum requirements as well as the vetoes for modeling. This way, potential problems for implementability of the models in the different software tools were identified and their use was banned. Five software tools were included, GaBi, openLCA, RangelCA, SimaPro, and Umberto. The next step was to test the EF impact assessment (IA) results of all EF-compliant secondary datasets. This way, differences coming from their implementation or of the EF IA method could also be identified before testing the results of the models. Furthermore, the development of an extension to the International Reference Life Cycle Data System (ILCD) format (eILCD) enabled importing and exporting models between software tools. Finally, the models developed for RPs and ROs will be tested in the five software tools. The problems faced in importing, calculating and comparing the results of the developed models in the different software tools together with suggestions for improving the data exchange between them is presented. The study resulted in the definition of an enhanced EF-compliant dataset format, possibly following the Data Model exchange (DMx) concept. Some claim different results in different software tools used, often generally pointing to different “software”, without being more specific. The reason may be rather bound to methodology, age, version, flow list and import-export interface aspects, or even a combination. This work is the basis to enable the reduction of software-system related issues and makes it easier to detect and prevent mistakes. Most importantly, now there is the commitment of the 5 tool developers to make available to all users in the course of 2018 a compliant import and export interface for the eILCD format. We believe this is a crucial step towards the exchange of data and models across software tools and the comparability of results.

195 LCA using real time information: the case of DEA-enabled monitoring of WWTP lifecycle environmental performances
A. Marvuglia, Luxembourg Institute of Science and Technology (LIST) / Environmental and Research Innovation (ERIN); D. Torregrossa, Luxembourg Institute of Science and Technology (LIST); E. Benetto, Luxembourg Institute of Science and Technology (LIST) / Environmental and Research Innovation

Life cycle assessment (LCA) is undergoing the effects of a data abundance era, which poses old (data storage) and new (data mining, computational speed) challenges. The deep integration of Internet of Things (IoT) in product- and service-oriented manufacturing systems has enabled a Big Data support for lifecycle modelling along the entire value chain, and the emergence of open-access LCA libraries nowadays allow the easy extraction of the power of crowd-sourced information. However, how to use this huge amount of data in a consistent way to obtain more precise, spatially and temporally differentiated life cycle inventories (LCIs) and life cycle impact assessment (LCIA) results is still an not easy task. In the case of wastewater treatment, the larger and larger availability of on-line measurements coming from sensors installed in many wastewater treatment plants (WWTPs) should theoretically enable daily benchmarking, ultimately allowing faster correction actions, when needed. However, WWTPs data still finds very limited use and is often simply stored. The aim of this work is to showcase an application of
temporally differentiated LCA performed with real-time high frequency data and present a methodology for the on-line assessment of the shift in the performance of WWTPs. The implemented methodology performs a DEA-based benchmark coupled with LCA to evaluate the environmental impacts linked to the operation of a WWTP. A web application of the system is currently being developed using the Shiny R package. It will enable plant managers to calculate and visualize LCA results in real time by modifying customizable parameters.

196 Enhancing Land Use Change modelling with IO data
J. Schmidt, Aalborg University / Department of Planning; M. De Rosa, BONSAI / Agroecology
Land Use Changes (LUC) are responsible for around 11% of global GHG emissions, nearly the same as the transport sector. This is about half of the GHG emissions from coal-based electricity production worldwide. Nevertheless, LUC are often excluded from LCA studies because ascribing the LUC to their drivers distinguishing between production sectors is challenging and requires a complex global inventory data modelling. In order to address this, 2-0 LCA consultants has been developing a model for indirect LUC (ILUC) modelling in LCA since 2011 as part of a crowdfunded project. Recently, the model has been integrating into the multiregional hybrid Input-Output model EXIOBASE, thus providing an unprecedented level of detail in iLUC modelling. Differentiation between use of land among regions of the world is based upon information on potential land productivity in different locations. The IO data allow identifying the land supplied by each country taking into account all land use trends. The agricultural land use module in EXIOBASE make use of FAOSTAT data, which provide time series on area and production per crop. The data allow modelling the global supply of land to the global market for land, distinguishing between land expansion (land transformation) and land intensifications (increased production per unit of land). The land transformation and intensification LCA activities are populated with data on carbon stocks of different land use types in all countries, and time series of fertiliser use in all countries. The current version of the model (version 4.3) includes the following elementary flows: emissions of CO₂, N₂O, NO₃⁻, NH₄ and resource inputs of accelerated denaturalisation caused by transformation of land. The iLUC model can be combined with any life cycle impact assessment (LCIA) model. Overall, the results show that for agricultural crops, iLUC increases the GHG emissions with 100-200%, for beef cattle 20-60%, for pigs 40-80%, for dairy products 40-60%, for wood products 30-50%, and for primary plastic 2-15%. The model is location agnostic and can be applied to any decision-making context concerning long-term effects of small-scale changes. The iLUC framework is now integrated in the global EXIOBASE model, thus accounting for all crops in all countries in the world. It has already been applied to more than 50 LCA studies and on several product categories.

197 WSmix: a globally regionalised Water Supply mix framework with current and prospective databases for use in LCA
S. P. Schmidt, ITAP ELSA; P. Roux, Istea / ITAP ELSA-PACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Istea; G. Junqua, Ecole des Mines d'Ales / LGEI; A. Sferratore, Société du Canal de Provence; Y. Penru, SUEZ groupe / CIRSEE; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istea - UMR ITAP
Freshwater comes from different sources that are unevenly distributed in the world and different water users (e.g. domestic, agriculture, industry) need different water quality standards provided by local (surface, groundwater, rain), external (inter-basin transfers) and alternative sources (e.g. sea water). Water from these sources are withdrawn and processed via water technologies using the local electricity mix. The combination of water sources and technologies results in a regional water supply mix (WSmix) for each specific use. Current LCI databases do not include these mixes when modelling processes leading to a poor representation of water supply systems and related environmental impacts in LCA. Furthermore, changes in water sources, caused by changes of climate and socio-economic factors, will occur in the future. These changes should be considering in LCA of products or infrastructure with long lifespans. This work aims to develop WSmix framework for modelling current and prospective water use related LCA impact assessment (LCIA) model. Overall, the results show that for agricultural crops, WSmix increases the GHG emissions with 100-200%, for beef cattle 20-60%, for pigs 40-80%, for dairy products 40-60%, for wood products 30-50%, and for primary plastic 2-15%. The model is location agnostic and can be applied to any decision-making context concerning long-term effects of small-scale changes. The iLUC framework is now integrated in the global EXIOBASE model, thus accounting for all crops in all countries in the world. It has already been applied to more than 50 LCA studies and on several product categories.

198 The evolution of database- and tool development for Agri-footprint
B. Durlinger, L. Kuling, Blonk Consultants
From performing individual Life Cycle Assessment (LCA) studies for specific products, the field is moving towards automated LCAs for full product portfolios and tool and database development. This ongoing evolution is a result of the increased quality and availability of background databases as well as an increased acceptance of LCA as the measurement and monitoring tool for environmental impact. However, a point has been reached where existing LCA software and data structures have become a limiting factor for further development. Therefore, we would like to present our recent developments regarding database and tool development for LCA purposes. Existing LCA software frameworks have become limiting in our database development, because they only have a limited set of calculation features and interfacing capabilities. Also, the data structure of existing LCA software has proven to be limiting. For example, there is no explicit distinction between a process, products/substances, and exchanges. This can result in loss of valuable information. Therefore, we have decided to develop our own database infrastructure and accompanying calculation and import/export modules, that provide enhanced flexibility. This allows for more freedom, we can now make our own choices on how data is stored, what types of analyses can be performed and how this information is presented to a user. In addition, we see a trend where LCA analysts are becoming more and more interested in advanced tools that utilise Life Cycle principles. For Agri-footprint 2018 we are therefore developing a completely new framework in a Python/Django environment that aims leverage the past developments of Blonk Consultants and Agri-footprint and utilise them to develop a cloud based Life Cycle Inventory datastore and calculation engine to support and improve both our internal data developments and to serve as a backbone for custom tools for users. With this presentation we hope to contribute to the advancement of LCA databases and tools by providing insight in recent Agri-footprint developments.

199 Poster spotlight: TU097, TU098

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
E. McCallum, Umea University; A. Sundelin, J. Hick, Umea University / Department of Chemistry; A. Alaniärä, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science
Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and ibesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L, 200 ng/L, 2000 ng/L, for temazepam and ibesartan, respectively). We then assessed how exposure affected fish behaviour in the laboratory (scototaxis to measure anxiety and activity responses) and in the field (downstream dispersal using PIT tags). We found no evidence that either pharmaceutical treatment affected behaviour in the laboratory scototaxis assay. In contrast, fish exposed to the high and low doses of temazepam dispersed faster downstream when compared to control fish. Ibesartan exposure did not affect fish behaviour in the field. Across all treatments, we also found that activity in the laboratory correlated with migration speed, indicating that fish that were more active in the laboratory also moved faster downstream in the wild. We discuss our findings in relation to differences in tissue bioconcentration for both pharmaceutical compounds in the model tissue of fish in our study and other results emerging from measuring how pollutants affect ecologically relevant behaviours in the field alongside standard and efficient laboratory assays.

201 Exposure to the widespread androgenic steroid 17β-trenbolone alters behaviour in fish
M.G. Bertram, Monash University / Biological Sciences; M. Saaristo, J.M. Martin, T.E. Ecker, C.P. Johnstone, B.B. Wong, Monash University / School of Biological Sciences
As a consequence, increasing amounts of pharmaceuticals are released into aquatic ecosystems via effluent runoff. Hormonal growth promotants are designed to have biological effects at low doses, often act on physiological pathways that are evolutionarily conserved across species, and have repeatedly been detected in ecosystems worldwide. However, despite being shown to cause altered development, reproduction and morphology in various non-target species, relatively little is known about the potential of HGPs to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (24 h) or field-detrcted (75 h) exposures to the growth promotants trenbolone, oxtremorel and teratogen shape and teratogen (GT) and a potent growth promoting veterinary pharmaceutical repeatedly detected in freshwater systems—on a suite of ecologically important behaviours in female eastern mosquitofish (Gambusia holbrooki).

We found that fish exposed to 17β-trenbolone were more active and exploratory in a novel environment (i.e. maze arena), while boldness was not significantly affected. Further, when tested for sociability, exposed fish were again more active and exploratory, and spent less time associating with a shoal of stimuli (i.e. unexposed) conspecific females. Lastly, when assayed for foraging behaviour, exposed fish spent a greater total amount of time within a foraging zone containing an array of prey items (chironomid larvae) than did unexposed fish, entered this zone more frequently, and were more likely to feed. Further, a significant effect of exposure was detected on the total number of prey items consumed, although treatment-induced increases in foraging behaviour were dependent on female size. Taken together, these findings highlight the potential for sub-lethal levels of veterinary pharmaceuticals detected in the environment to alter sensitive behavioural processes in wildlife across multiple contexts, with possible ecological and evolutionary implications for exposed populations.

202 Selective grazing behaviour of chironomids between three microalgal species under pesticide pressure J.N. Henry-Ormanii, Irstea / EABX-CARMA; C.N. Doose, INRS - Centre Eau Terre Environnement; B. CHAUMET, Irstea; N. Mazzella, Irstea Bordeaux / UR EABX; N. Majdi, École / UMR 5245 CNRS; J. Vedrenne, S. Morin, Irstea Bordeaux / UR EABX; W. Traumsprger, Bielefeld University / Animal Ecology.

The herbicide diuron and the insecticide imidacloprid are amongst the most frequently detected pesticides in French rivers, and each is known to affect many aquatic organisms. However, it is less examined whether and how both pesticides together might interact further. Here, we tested the hypothesis that co-exposure to sub-lethal levels of imidacloprid and diuron might affect fish behaviour such as modification of biological interactions within freshwater microbial communities. This study was undertaken to determine the effect of diuron and imidacloprid alone and in combination on the feeding behaviour of chironomid larvae. A first experiment measured the impact of the different contamination conditions at environmental concentrations (5μg L⁻¹ for each pesticide) on the grazing rate of chironomids on three microalgal species, independently. Therefore, two diatom species, Gomphonema gracile (two different morphotype: normal (GG) and teratogen (GT)) and Planolithium lanceolatum (PL), and one green alga Pseudokirchneriella subcapitata (PS) were offered as food, during 24h. Protein and lipid contents in microalgae were analysed subsequently. Each pesticide condition elicited a different grazing rate in chironomids with regards to algal species and their nutritional quality, with a general preference for Gomphonema gracile with teratogen shape and Pseudokirchneriella subcapitata. In a second experiment (cafeeteria), food selectivity of chironomids was determined under similar contamination conditions during 4h: Under diuron, larvae switched equally among microalgae, then were as mobile as in the control without pesticide. However, imidacloprid and the pesticide mixture condition altered chironomids’ movements and grazing behaviour. In these experiments, we highlighted that chironomids feeding behaviour and food preferences are impacted by pesticides. Herbicide and insecticide exposure, alone or in combination, had contrasting effects on grazing, both directly on the larvae or indirectly (food selectivity according to its quality). Our study illustrates the value of considering the impacts of toxicants on target and non-target organisms across trophic levels to improve ecotoxicological risk assessment in an ecosystem perspective.

203 Environmental levels of anxiolytic pharmaceuticals alter migration of Atlantic salmon in both lab and field T. Brosend, M. G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Arnold, University of York / Environment Department, University of York / Environment; R. Shore, Centre for Ecology & Hydrology (NERC); J. Lane, Anistream, Ukraine / Environment; B. CHAUMET, Irstea; I. Domingues, University of Aveiro / CESAM; M. G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Arnold, University of York / Environment;

Several species of bird are known to forage directly on invertebrates at wastewater treatment plants (WWTPs). Representing an exposure route to a range of contaminants including pharmaceuticals. The selective serotonin reuptake inhibitor (SSRI) fluoxetine is heavily prescribed and has been widely detected at WWTPs. We used a combination of behavioural and physiological endpoints to assess the effects of fluoxetine, specifically: 1) object neophobia, 2) exploration in a novel environment, 3) activity levels, 4) faecal corticosterone (CORT) metabolite concentration; and 5) leg skin temperature. Compared with pre-treatment data, fluoxetine-treated birds became less neophobic on average after six weeks of dosing, indicating a decrease in anxiety behaviour. There was no such reduction in neophobia in the control group. After six weeks of dosing, control birds became more active on average but fluoxetine-treated birds showed no increase in activity, evident including the feminization of fish by contraceptive residue. However, recent work suggests that important effects of pharmaceuticals in aquatic environments are much more widespread than currently believed, and that these effects may result in major changes in species interactions, population survival and ecosystem functioning. In several earlier laboratory studies, we have shown that concentrations of pharmaceuticals presently found in waterways alter important behavioural traits in both aquatic macroinvertebrates and fish, and that this in turn affects both feeding efficiency and predation risk. These results suggest that pharmaceutical contamination of aquatic environments may change species interactions, in particular predator-prey interactions, with severe ecosystem-effects as potential consequence. Recently our research focus has turned towards realistic large-scale studies in lakes and rivers using acoustic telemetry to test if findings from the lab also hold in natural settings. Here I present results from one such study comparing effects of environmental levels of the anxiolytic pharmaceutical Oxazepam on migration pattern of Atlantic salmon (Salmo salar) in the lab and the field. In the lab, salmon exposed to the drug migrated approximately twice as fast as unexposed salmon and the subsequent field-study generated similar results, validating the results found in the lab. This pharmaceutically induced change in migration-intensity has the potential to be a key determinant between survival and mortality of salmon individuals and as such important for population persistence as migration intensity is believed to be adapted to the environmental conditions of the river in question. The overall finding of recent studies suggests that effects of pharmaceutical contamination of natural systems might be much more widespread than we predict based on conventional ecotoxicological tests.

204 Can personality influence the response to fish to environmental contaminants? M. Oliveira, University of Aveiro; M. Sampaio, T. Santos, University of Aveiro / Biology Department / CESAM; A.L. Machado, University of Aveiro / CESAM Department of Biology; M. Barbosa, Department of Biology & CESAM - University of Aveiro / Biology; I. Domingues, University of Aveiro / CESAM; M. Oliveira, University of Aveiro / CESAM

Stress is a determinant factor reducing animal welfare. Currently, it is recognized that animals react differently as a function of their personalities, or stress coping styles (i.e. consistency in behavioural and physiological responses across time or contexts). However, the role of personality in modulating individual response to environmental contaminants has received limited attention, despite the recognition that personality traits associated with a shy-bold continuum play an important role in animal fitness. Knowing that pharmaceuticals can interfere with personality, one question arises: what is the role of personality on animals’ response to stressors? In this research, we assessed for the potential to be a key determinant between survival and exploration of a novel environment into shy and bold individuals, and subsequently exposed during 96h to carbamazepine, a human pharmaceutical, suggested as a marker of anthropogenic pollution. Assessed responses included behaviour (distance swan, position in the tank and time spent swimming) and biochemical markers associated with oxidative stress, neurotransmission and energy metabolism. Overall, our results showed significant differences between control shy and bold organism with behaviour endpoints demonstrating to be very sensitive to stressor conditions. Although carbamazepine alone did not show considerable effects in the assessed endpoints, strong interactions were found between personality and pharmaceuticals, supporting further studies.

205 Effects of fluoxetine on anxiety-related behaviours and physiology in a songbird S.E. Whitlock, Environment Department, University of York / Environment; R. Shore, Centre for Ecology & Hydrology (NERC); J. Lane, Animal and Plant Health Agency; K. Herborn, Newcastle University / Centre for Behaviour and Evolution; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Arnold, University of York / Environment

Several species of bird are known to forage directly on invertebrates at wastewater treatment plants (WWTPs). Representing an exposure route to a range of contaminants including pharmaceuticals. The selective serotonin reuptake inhibitor (SSRI) fluoxetine is heavily prescribed and has been widely detected at WWTPs. Since fluoxetine is commonly prescribed for anxiety, we hypothesised that the antidepressant could modulate anxiety behaviour and physiology in exposed birds. Anxiety is an important state which arises in response to a real or perceived threat, enabling the individual to respond appropriately. Contaminants with the potential to alter anxiety-related behaviours are thus of concern to wildlife. We conducted a study to investigate the effects of environmental levels of the anxiolytic pharmaceutical fluoxetine on the model aquatic bird, the Eurasian starling (Sturnus vulgaris). We used a combination of behavioural and physiological endpoints to assess the effects of fluoxetine, specifically: 1) object neophobia, 2) exploration in a novel environment, 3) activity levels, 4) faecal corticosterone (CORT) metabolite concentration; and 5) leg skin temperature. Compared with pre-treatment data, fluoxetine-treated birds became less neophobic on average after six weeks of dosing, indicating a decrease in anxiety behaviour. There was no such reduction in neophobia in the control group. After six weeks of dosing, control birds became more active on average but fluoxetine-treated birds showed no increase in activity,
indicating increased lethargy in the fluoroxetine birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that fluoroxetine-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, fluoroxetine causes vasodilatation, in which birds will affect the ability to thermoregulate. This study provides further evidence that low, environmentally relevant concentrations of pharmaceuticals can cause subtle changes to behaviour and physiology that are predicted to impair the capacity of wildlife to respond appropriately to environmental changes.

Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment?

206 Does single compound risk assessment protect from mixture effects and multiple stress?

P. von der Ohe, UBA - Federal Environment Agency / IV 2.2 Pharmaceuticals

There is clear evidence that stress from anthropogenic activities can have profound local and regional effects on aquatic communities. To what extent chemicals are responsible remains largely unknown. The question whether a single compound risk assessment can protect from further deterioration of our water resources is discussed in the light of current mixture toxicity frameworks and multiple stress considerations. Here we present a European wide risk assessment of organic chemicals, based on regulatory monitoring data at about 6,000 monitoring sites available from the Dutch Environment Agency (EEA). For the more than 600 mostly industrial substances, including many detergent ingredients such as benzotiazol, the available quality standards were collated or predicted from reliable QSAR models. Results showed that organic chemicals are likely to exert long-term effects on sensitive species in more than 5% of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC in consecutive years as well as from various substances. The monitoring programs considered in this study often include only a subset of the chemicals expected. Hence, our assessment is likely to underestimate the actual risk. Nevertheless, the results show that multiple exposures at each site is rather the rule than the exception. Finally, we discuss whether chemicals from WWTP have significant effects on aquatic invertebrate communities as compared to effects from local habitat. For that purpose, we analysed two data sets on macroinvertebrate communities where we have a) similar chemical stress, but differing habitat quality and b) similar habitat quality but differing chemical stress. The results indicate that in direct comparison, chemical stress induced larger effects as compared to habitat degradation. Our results therefore clearly indicate that chemical pollution is still a large-scale environmental problem that requires far-reaching, holistic mitigation measures to preserve and restore ecosystem health. It also suggests that current risk assessment approaches on a substance by substance bases are likely not protective for the environment.

207 Threshold trends in wildlife taxa: challenging and evaluating our chemical- and environmental risk assessments of chemicals and their mixtures

L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; D. De Zwart, DiDZ Ecotoxicology / Centre for Sustainability Environment and Health; J. Postma, Ecofide; M.C. Zijp, RIVM / Centre for Sustainability, Environment and Health

“Big data” are a potential goldmine for studying and contextualizing chemical and environmental risk assessments, as they enable relating predicted risks to observed impacts. This can confirm or challenge our chemical risk assessments, by checking whether Environmental Quality Standards provide sufficient safety, and whether or not mixture exposures cause problems not captured in the widely used ‘single-chemical plus safety factor’ approaches. Digging the goldmine asks for – first – data collation, and then: a powerful design which can be borrowed from paleoecology. For that purpose, we analysed two data sets on macroinvertebrate communities where we have a) similar chemical stress, but differing habitat quality and b) similar habitat quality but differing chemical stress. The results indicate that in direct comparison, chemical stress induced larger effects as compared to habitat degradation. Our results therefore clearly indicate that chemical pollution is still a large-scale environmental problem that requires far-reaching, holistic mitigation measures to preserve and restore ecosystem health. It also suggests that current risk assessment approaches on a substance by substance bases are likely not protective for the environment.

208 How much do improvements in wastewater treatment benefit downstream macroinvertebrate populations?

A. Johnson, CEH Wallingford; F. Edwards, Centre for Ecology Hydrology Maclean Building; M.D. Juergens, Centre for Ecology and Hydrology / Wallingford; H. Vincent, Centre for Ecology Hydrology Maclean Building

The River Ray, which is a small tributary of the Thames (UK), offers an unrivalled opportunity to examine the impact of changes in wastewater treatment on the resident aquatic wildlife. This opportunity exists because the waste from the 170,000 plus people of Swindon discharges into this small 12 km long waterbody, such that the downstream mean annual flow is composed of 65-80% treated effluent. The downstream monitoring sites showed a sustained improvement in macroinvertebrate diversity starting from 1991 onwards. This sustained improvement for macroinvertebrates coincided with a 10-fold drop in ammonia, halving of biodegradable organics, (BOD) and improvement in dissolved oxygen associated with the conversion of the Swindon plant from trickling filter to nitrifying activated sludge. There were no dramatic changes in metal concentrations over the key early 1990s’ period unlike the main sanitary determinants. Whilst there was no change in overall flows, winter water temperatures downstream of Swindon rose over the course of the 30 year monitoring period. We could not identify a clear relationship between chemical and physical signals and the changes in abundance are not known. The recovery of macroinvertebrate diversity is slow and has not yet returned to the expected range for such a river, however, it was noted that the habitat is not ideal. This project has demonstrated the immense power and value of consistent long-term parallel chemical and wildlife monitoring.

A. Johnson, François Edwards, Monika D. Jürgens, Helen Vincent Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 5EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC Track 7, Session 7.2 Preference Platform

209 Biometric parameters of the bream (Abramis brama) as indicators for long-term changes in environmental quality - results from the German ESB

D. Teubner, Trier University / Biogeography; M. Paulus, M. Veith, Trier University; R. Klein, Trier University / Biogeography

Fish health depends on the macroinvertebrate community from the application of tertiary granular activated charcoal treatment (GAC) lasting from 2008 to 2014. There is clear evidence that stress from anthropogenic activities can have profound local and regional effects on aquatic communities. To what extent chemicals are responsible remains largely unknown. The question whether a single compound risk assessment can protect from further deterioration of our water resources is discussed in the light of current mixture toxicity frameworks and multiple stress considerations. Here we present a European wide risk assessment of organic chemicals, based on regulatory monitoring data at about 6,000 monitoring sites available from the Dutch Environment Agency (EEA). For the more than 600 mostly industrial substances, including many detergent ingredients such as benzotiazol, the available quality standards were collated or predicted from reliable QSAR models. Results showed that organic chemicals are likely to exert long-term effects on sensitive species in more than 5% of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC in consecutive years as well as from various substances. The monitoring programs considered in this study often include only a subset of the chemicals expected. Hence, our assessment is likely to underestimate the actual risk. Nevertheless, the results show that multiple exposures at each site is rather the rule than the exception. Finally, we discuss whether chemicals from WWTP have significant effects on aquatic invertebrate communities as compared to effects from local habitat. For that purpose, we analysed two data sets on macroinvertebrate communities where we have a) similar chemical stress, but differing habitat quality and b) similar habitat quality but differing chemical stress. The results indicate that in direct comparison, chemical stress induced larger effects as compared to habitat degradation. Our results therefore clearly indicate that chemical pollution is still a large-scale environmental problem that requires far-reaching, holistic mitigation measures to preserve and restore ecosystem health. It also suggests that current risk assessment approaches on a substance by substance bases are likely not protective for the environment.

210 The burden of being a slow-life cycle species: freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology

Sanchez Heping, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; N. Poulet, Agence Française pour la Biodiversité / Pôle Ecosystèmes Aquatiques, ABF-IMFT; A. BENSARD, Centre d’Ecologie Fonctionnelle et Evolutive / Biogéographie et Ecologie des Vertébrés Population dynamics of aquatic species and ultimately their population growth rate (λ), must be known to properly define species conservation status and plan appropriate conservation actions. This can also essentially mean that there are inter-specific variations in demographic and life history traits influence population dynamics. For this purpose, we implemented an integrative approach focused on 18 common freshwater fish species representing 94 % of fish abundance and 88 % of fish biomass sampled since 1990 in 546 monitored sites in France. Abundance and biomass growth rates were estimated with space-models and fish length trends with quantile regressions. To further study correlations between fish abundance, biomass, fish-length trends and fish life traits (life history strategies, species trophic position, habitat preferences and thermal tolerance) we performed multivariate analyzes. The present work demonstrates that during the last decades, 10 species
exhibited significant decline in abundance, 2 species were in expansion and fish abundance remained stable for 6 species. The correlation between biomass and abundance growth rates was also very high (R²=0.93). The intra-specific trends in fish length over the studied period also showed a severe decrease among the largest individuals (quantile 0.75 and 0.90) and was correlated to severe biomass decline in several species. This result reflect progressive alterations in the population size / age structure suggesting that a decrease in growth and survival might be responsible of the decrease observed. Among the demography and ecological traits we investigated, generation time and fish maximum length were the most correlated to species population growth rates indicating the decline of slow generation time species. These results are discussed with regards to global pressures which could explain large scale decline of periodic species with a focus on chemical pollutants which explain body growth decrease, juvenile and adult survival alterations due to micropollutant exposures. Further attention will be paid to discuss conservation measures and life stages which should be protected in priority to favor periodic species recovery.

211 The use of natural historical collections to reconstruct temporal trends of the exposure to major contaminants in different white-tailed eagle (Haliaeetus albicilla) populations

J. Sun, Antwerp university / Department of Biology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; A. Covaci, University of Antwerp, Toxicological Centre / Toxicological Centre Dep of Pharmaceutical Sciences; B. Hipskou, Swedish white-tailed eagle Monitoring; G. Malavannan, University of Antwerp / Toxicological Center; J. Søndergaard, Aarhus University / Arctic Research Centre; K. Thorup, A. Totrup, Natural History Museum of Denmark; M. Eens, University of Antwerp / Department of Biology; I. Eulaers, Aarhus University / Department of Bioscience Understanding temporal trends of persistent contaminants in wildlife is critical for the assessment of the pattern here observed, present and future health risks. We have established a retrospective examination of Mercury (Hg) and several organohalogen contaminants (OHCs) in Swedish, Norwegian and Greenlandic white-tailed eagle (Haliaeetus albicilla) using body feathers obtained from natural history and ornithologist collections. We analyzed feathers for Hg, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), as well as stable carbon and nitrogen isotope signatures. The aims of the present study were: 1) to retrospectively reconstruct temporal trends of major contaminants in relation to anthropogenic emissions and regulations, 2) to interpret how dietary habits (using stable isotope proxies) may have affected the temporal trends, and 3) to document a potential spatial gradient from high (Sweden) to low (Greenland) anthropogenic contaminant input. Strong evidence for spatiotemporal patterns was found based on preliminary results for Hg and OHCs in the Swedish and Norwegian populations. Swedish white-tailed eagle feathers showed concentrations associated with adverse physiological effects, thus supporting the earlier observed dramatic decline in productivity. Hg concentrations were much lower in the Norwegian feathers, while the peak PCB exposure is of the same order of magnitude as the average PCB exposure for the Swedish population (median = 3.29 ng g⁻¹). Clear declining trends were observed for both the Swedish and Norwegian time series after 1970s. We did not detect PBDEs before 1970 in the Swedish or Norwegian time series, although concentrations increased steeply during the 1980s, decreasing trends were observed afterwards. Hg concentrations in the Greenlandic time series were stable before 1940, but showed an increasing trend from 1980 to 2013. These results suggest that changes in historical and recent anthropogenic emissions strongly shape temporal changes of persistent contaminants in avian top predators. In addition, the relative interplay between local versus long range transport have likely affected the spatial pattern of contamination levels. The here presented preliminary results will be complemented with data for the Greenlandic populations as well as emission and stable isotope data to disseminate the relative effects of dietary habits and anthropogenic contaminant sources.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (I)

212 Findings of a SETAC Technical Workshop on Bioavailability-based Water Quality Criteria

C.E. Schlekat, NiPERA; K. Gallagher, U.S. EPA / Office of Water; B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology A workshop entitled “Technical Workshop on Bioavailability-based Water Quality Criteria” was held under the auspices of the Society of Environmental Toxicology and Chemistry on 3-8 December 2017 in Pensacola, Florida, USA. The goal of the workshop was to evaluate the state-of-the-science regarding metals bioavailability models and their use from a regulatory perspective. A second, but equally important, goal was to provide a scientific forum for discussions that could inform the further incorporation of bioavailability concepts into regulatory approaches for deriving environmental standards. This state-of-the-science regarding the ability to accurately predict the toxicity of metals in the environment to aquatic organisms has increased rapidly in recent years. Workshop participants reviewed the current state-of-the-science on aquatic bioavailability information for metals and on methods to model bioavailability under a range of environmental conditions. Participants also discussed the technical challenges associated with applying bioavailability-based approaches, especially in a regulatory context. The outcome of the workshop will support expanded incorporation of metal bioavailability information into global regulatory frameworks. Approximately 40 invited scientists representing industry, government, and academia participated in the workshop. Participants were divided into five groups with each group addressing one of the following meeting objectives: Review of the state-of-the-science regarding the issue of metal bioavailability and toxicity to aquatic organisms; Determine the extent to which available biotic ligand models (BLM)/multi-linear regression (MLR)-based models/other alternative methods offer a means of improving metal bioavailability; and to which they are protective of aquatic life. Develop technical information regarding the type and quantity of data necessary to develop and apply bioavailability-based aquatic toxicity models, Develop recommendations for approaches to validate bioavailability-based models, and Provide recommendations for suggested measures of bioavailability for bioavailability-based aquatic effects models. Workshop findings will be presented and will later be published in the form of a SETAC “Summary document” and a series of manuscripts to be submitted to a SETAC journal.

213 Modifying factors for nickel speciation and toxicity in seawater

W. Chen, Wilfrid Laurier University; S. Sherman, Wilfrid Laurier University / Biology; J. McGee, Wilfrid Laurier University / Department of Biology; R.C. Santore, Windward Environmental, LLC; T. Blewett, University of Alberta; G. Merrington, WCA Environment Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry Nickel (Ni) toxicity in seawater is of increasing concern because of coastal Ni mining and processing activities. Determining Ni speciation is vital to understanding and predicting Ni toxicity and ultimately for bioavailability based nickel risk assessment. Application of existing freshwater bioavailability based approaches for nickel in salt water predicts negligible binding of Ni to dissolved organic matter, but there are several examples of toxicity tests in natural seawater that are protective compared to artificial seawater control samples. Determining Ni speciation is a key step in this research. In this study Ni speciation was determined in real saltwater samples of diverse geographic origin from the east coast of the United States and Canada. The divalent Ni free ion in these synthetic and real seawater samples was quantified using Ion Exchange Technique (IET) with Ni measured by Graphite Furnace Atomic Absorption (GFAA). The measured Ni²⁺ values were compared with model predictions (i.e. Visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawater. For the most part IET-measured [Ni²⁺] agreed very closely with model predictions. In the same defined solutions, 96-hour Ni embryo toxicity tests were performed for a sea urchin (S. purpuratus). The dose response curves were expressed both as total dissolved Ni concentration ([Ni₃⁺]) and free Ni concentrations from IET ([Ni²⁺]). If the Ni toxicity is explained by [Ni²⁺], all the toxicity response curves of different model ligands will overlap and this was in fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPERA Inc.

214 Acute bioavailability models for nickel: Development and regulatory application

K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology; P. Van Sprang, I. Verscaigne, ARCHE; A. Peters, wca; C. Van den Gunst, NiPERA / Ecotoxicologist Chronic bioavailability models for nickel are well-established. For example, the Annual Average Ni Environmental Quality Standard (AA-EQS) under the European Union’s (EU) Water Framework Directive (WFD) is based on normalization of chronic Ni ecotoxicity data using chronic Ni bioavailability models. Acute Ni models have been developed for invertebrates, fish, and algae, but the Inter-toxicity and non-model species and to demonstrate how they can be applied to derived MAC values. Acute Ni ecotoxicity data (eight species from 13 different studies) were identified from the literature. Data were accepted for analysis if acute Ni toxicity for a species was tested >2 tests differing in physico-chemistry.
Acute Ni bioavailability models (3 invertebrate models, 2 algae models, and 1 fish model) were used to evaluate the ecotoxicity data. To simplify the normalization process, an “average animal” bioavailability model was developed using a weighted average of parameters for existing models. Because crustaceans are typically among the most sensitive organisms to Ni exposure, and because the fish model did not capture pH effects on acute Ni toxicity to crustaceans very well, an “average crustacean” model was also developed. Model parameters for the 3 crustacean models were used to construct the “average crustacean” model. Both the “average animal” and “average crustacean” models reduced intraspecies variability considerably among the available Ni ecotoxicity data. For example, the “average animal” model predicted 98% of the 193 individual acute ecotoxicity data points within a 3-fold error, and 90% within a 2-fold error. The “average crustacean” model did not perform well. Although this model clearly showed a better ability to predict the effect of pH on Ni toxicity to cladocerans. The models were applied to an acute Ni ecotoxicity dataset to derive bioavailability-based MAC for European water bodies with typical ranges of water chemistry.

215 Bioavailability and bioaccumulation of uranium: From lab experiment to modelling

A. Husson, Mines ParisTech / Hydrodynamics and reactions team (HR); M. Learmakers, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry; M. Descoste, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University / Geosciences Hydrodynamics and reactions team (HR); R.C. Santore, Windward Environmental, LLC; E. Nordheim, Aluminium Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; B.A. Stubblefield, King Abdullah University of Science and Technology; A. Husson, Mines ParisTech / Hydrodynamics and reactions team (HR)

Environmental regulations are becoming more and more ecosystems-oriented. In this respect, the habitat’s faunal biodiversity is targeted, meaning the contaminant’s bioavailability is taken into account. The latter depends on the geochemical conditions of the aquatic system, which define the chemical speciation. For several elements, Environmental Quality Standards (EQS) and Sediment Quality Standards (SQS) have been proposed. For non-priority elements such as Uranium, EQS and SQS should be supplemented with national standards. As the bioavailable fraction in sediments is dependent on geochemical factors and sediment mineralogy, it is important to investigate the role of sediment composition on the bioaccumulation of uranium in benthic organisms. In the present study, laboratory experiments were performed on the bioaccumulation of uranium in the larvae of the non-biting midge Chironomus riparius exposed to specific mineralogical phases (pure Quartz, 10% Kaolin/90% Q, 10% Siltstone/90% Q, 10% Ferrihydrite (FOH)/90% Q and a mixture of the 4 mineral phases (3.3% Kaolin/3.3% Siltstone/3.3% (FOH) and 90% Q) spiked with uranium at two different concentration levels. During a ten days’ exposure experiment, the uptake of uranium in the chironomid was investigated and the concentrations of uranium in sediment, overlying water, pore water were measured as well as the composition of major ions and physicochemical parameters. Diffusive Gradients in Thin Films (DGT) devices were deployed simultaneously to investigate the relationship with the uptake of uranium in the chironomid larvae. Sediment to porewater partition coefficients (Kd) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Quotient (BSQ) was found for quartz (1), followed by Ferrihydrite (9) and Siltstone (8) and the lowest for the mixed composite sediment (1). DGT labile uranium porewater concentrations account for 70% of the uranium in porewater for all mineral phases except the quartz, where Cdet only accounts for 10% of the uranium in porewater. Uranium accumulation on the DGT units is correlated with the accumulation in the chironomids. Results obtained by using the Geochemical Speciation and Code (CHESS) to model the uranium sorption behaviour and chemical speciation in the aqueous phase. These results are compared with the proposed regulations by IBSN on uranium bioavailable chemical species.

216 Empirical Investigations into the Toxicity and Bioavailability of Aluminium to Aquatic Species

B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; W.J. Adams, Red Cap Consulting; R. Genser, GEI Consultants / Ecological Defense; R.C. Santore, Windward Environmental, LLC; E. Nordheim, Aluminium REACH Consortium

Implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in: 1) the generation of large amounts of empirical toxicity data and 2) increased our understanding of the relationships between water physicochemical parameters and toxicity. In this study, we present the requirement of the programs used to describe the chronic toxicity of regulated chemicals to a variety of aquatic organisms. To address possible data gaps in the Al database, a series of chronic toxicity tests were conducted with freshwater organisms. Aluminium toxicity is a function of its speciation and this is a function of water pH. Previous chronic toxicity tests with Al were typically conducted under acidic test conditions and few studies have been conducted at pHs more typical of natural surface waters. The studies reported here investigated the chronic toxicity of Al at pH 6.0 to 8 freshwater species. The species tested were the great pond snail (Lymnaea stagnalis), a rotifer (Brachionus calyciflorus), an aquatic oligochaete (Aeolosoma sp.), a midge (Chironomus riparius), an amphipod (Hyalella azteca), an aquatic plant (Lemna minor), and two fish, the fathead minnow (Pimephales promelas) and zebrafish (Danio rerio). Chronic test durations ranged from 48 hours to 35 days. The most sensitive species was the zebrafish (10% effect concentration (EC10) of 98 µL/L total Al) based on growth effects. The least sensitive species was Lemna minor, with an EC10 of 2175 µg/L total Al as total dry weight. A series of chronic and short-term chronic toxicity tests with Ceriodaphnia dubia, fathead minnows, and the algae (Pseudokirchneriella subsuccinata) suggest that modifying factors such as pH, dissolved organic carbon (DOC), hardness, and temperature have a large impact on the bioavailability and toxicity of Al to aquatic organisms.

217 Main factors responsible for the environmental degradation of rivers in a basin dedicated to gold mining using ecological predictive models. Case study Ponce Enriquez


The irreversible effects that the environment has suffered due to anthropogenic activity has reduced the availability of water for living beings, both in terms of quantity and quality. Industrial, agricultural, mining and urban development activities have in many cases led to the generation of pollutant discharges that threaten the health of our ecosystems. The impacts of mining activity on aquatic ecosystems have been widely documented, reporting the deterioration of water quality, the impact of biodiversity, as well as the release of heavy metals of potential accumulation in organisms and subsequent biomagnification through the food chain. Although it is known that non-technical mining activity affects the environment, it is necessary to identify and prioritize those factors related to mining activity that have a greater impact on the ecosystem (e.g. extraction, cyanidation, amalgamation). The identification of these factors would allow environmental control authorities to prioritize management actions focused on those parameters with the greatest impact, thus mitigating the impact of this activity on aquatic ecosystems. To illustrate this, the present study conducted in the Ponce Enriquez area seeks, through the construction of predictive models based on decision trees, to discriminate those environmental factors responsible for the environmental degradation observed in rivers and streams in the study area. In order to determine the environmental quality of the sites visited, the application of the BMWP / Col index was used, which is based on the structure of the macroinvertebrate community present. Additionally, a set of environmental variables of water and sediment quality were used to construct the models based on decision trees, to discriminate those environmental factors responsible for the environmental degradation observed in rivers and streams.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (I)

P. Bauerlein, KWR / Analytical and Environmental Chemistry; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; S. Mintenig, Utrecht University / Copernicus Institute of Sustainable Development; A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; H.M. Ohlendorf, CH2M

Detecting microplastics and determining actual concentrations and sizes of plastic particles present in the environment is essential to assess the risks that are posed by plastic particles. Microplastics have been detected globally in various aquatic ecosystems. The determination of microplastics is hampered by the high methodological challenges. But yet, its formation was proven experimentally and, for the first time, its presence in marine surface water samples confirmed. Building on those results, we further propose a framework that is able to consistently determine a broad size spectrum of plastic particles in an aqueous environmental sample. The results from initial tests confirm the general applicability of individual techniques to, firstly, sample and, secondly, detect plastic sizes and polymer types. To obtain representative results, a sampling strategy is needed to concentrate plastic particles. Crossflow ultrafiltration is applied to concentrate microplastics from 100 into 0.5 L and yields in a reproducible particle recovery of 54 ± 2 %. Microplastics are detected using FTIR-microscopy which is limited to a minimum particle size of 28 µm. For microplastics field- flow- fractionation, that reveals information on the particle sizes, and pyrolysis GC-MS, that is used to identify the polymer types, are
applied. Under the given settings the latter requires a mass of approximately 100 ng to identify polystyrene in an environmental sample by which this technique seems promising for the detection of nanoplastics. The pre-concentration by crossflow ultrafiltration reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 μg L⁻¹ in an aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microwave assisted irradiation for the analysis with FTIR-microscopy. By this, the results of spectrotic and thermal degradation analyses (e.g. pyrolysis GC-MS) can be combined and compared.

219 Trace particulate plastic analysis in environmental systems: synthesis and utilisation for sludge and microplastics and microscopic analysis of C. F. Schmidt, M. Schmiedenger, Eawag Swiss federal Institute of Aquatic Science and Technology; D.M. Mitran, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Risk and Management Research on particulate plastic (nano- and microplastic particles and fibers) and their distribution in the environment has intensified in recent years; but truly quantitative analytical capabilities, even at the bench scale, has remained elusive in part due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic, chemically entrapped tracer can provide a robust way to more easily, accurately and quantitatively detect particulate plastic in complex environmental and biological media. In this study, a suite of methods to synthesize a variety of particulate plastics of various sizes (100 nm to 1 mm), surface morphologies/charges and polymers (polystyrene, polyester, polypropylene and low density polyethylene). Each variant has an embedded metallic fingerprint (Pt, In, Au; approximately 0.5% metal/wt) which can be used to detect plastic by common analytical techniques, such as ICP-MS. To highlight the utility of this approach, dilute concentrations of particulate plastic were measured in various media including river water, municipal wastewater treatment plant effluent and wastewater sludge. Nanoplastics, for example, were detected three orders of magnitude lower than the concentration than similar particles with a fluorescence label. After ensuring the metal tracer was stable over time, digestion methods were developed which took into consideration the specific polymer and metal in question to achieve a minimum of 85% recovery in every matrix. Furthermore, the particulate plastics synthesized were spiked into natural aquatic samples to represent different stages of a municipal wastewater treatment plant to determine how various particulate plastics move through the system. In this way, some conclusions could be drawn concerning particle behaviour, aggregation and the likelihood of microplastics and the potential for microplastics to be discharged to freshwater within wastewater treatment effluent. Beyond the case study specifically highlighted here, these metal laden particulate plastic particles can be used as a high sensitivity method for characterizing interactions with organisms at trace concentrations. By using these materials, bench scale and pilot scale studies can be used as a bridge to understand the environmental processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

220 Detection of polymers in treated waste water using TED-GC-MS C. Geodecke, K. Altmann, Bundesanstalt für Materialforschung und Prüfung; C. Bannick, Umweltbundestand; E. Kobler, Technische Universität Berlin; M. Ricking, UBA Umweltbundesamt; T. Schmitt, Berliner Wasserbetriebe; U. Braun, BAM- Forst; were involved in a project. The aim of the project, initiated using TED /5.3 Mechanics of Polymers Sampling and the analytical tool, the so-called "Tracer Enrichment Device" (TED), are an important subject of current research. In the environment, (photo-) oxidation processes and mechanical abrasion lead to changes they undergo as a result of various weathering processes, like biofilm formation and microorganisms. The presence of large quantities of plastic waste and its fragmentation in various environmental compartments are an important subject of current research. In the environment, (photo-) oxidation processes and mechanical abrasion lead to the formation of microplastics. However, until now, there are no established quality assurance concepts for the analysis of microplastic (≤ 5 mm) in environmental compartments, including sampling, processing and analysis [1-4]. The aim of the present work is the development of suitable examination methods and protocols (sampling, sample preparation and detection) to qualify and quantify microplastic in urban water management systems. At first a fractional filtration system for sampling and the analytical tool, the so-called TRACER-MS (thermal desorption gas chromatography mass spectrometry) was developed. The TRACER-MS method is a two-step analytical procedure which consists of a thermal extraction where the sample is annealed and characteristic decomposition products of the polymers are collected on a solid phase. Afterwards these products are analysed using GC-MS [5]. The developed fractional filtration for sampling and the sampling technique for detection were used for quantitative analysis to screen the waste water influent and effluent of a Berlin waste water treatment plant for the most relevant polymers, polystyrene (PE), polypropylene (PP), poly(styrene (PS), polyethylene terephthalate (PET) and polyamide (PA). The results of the study revealed that the polymers PE, PS and PP were detected in the effluent, and PE and PS were found in the raw waste water of the sewage treatment plant in Ruhleben, Berlin. Differences in polymer types and amounts were detected at different sampling dates and within different sieve fractions. Much higher amounts of polymers were observed in the raw waste water. The peak areas of the decomposition products, used for quantification of the polymers, were adjusted using so-called response factors since the TED-GC-MS method is more sensitive for PP and PS than for PE. It has been shown that PE is the most dominant polymer in the samples. Comparing the masses of polymers in the effluent and in the raw sewage, a removal of 97 % of the polymers in the water treatment plant can be assumed. These results are consistent with the literature where removal rates between 98-99 % were described [6-7].

221 Soil and sludge: A time and cost-effective method for extracting microplastics from complex, organic-rich environmental matrices R. Hurley, NIVA - Norwegian Institute for Water Research; A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; M. Olsen, Telemark University College; L. Nizzetto, NIVA This study presents a very little existing literature on microplastics in organic-rich substrates such as soil or sewage sludge. The organic components, as well as the complexity of the solid matrix, complicates the extraction process. No standardised methodology has thus far emerged. This study aims to establish an effective extraction technique appropriate for the monitoring of microplastic contamination in soil and sludge samples. Four main protocols (including two temperature and concentration variants) were tested for the removal of organic material followed by a density separation process. This approach was selected to afford comparability with existing sediment microplastic analyses. The selected reagents were: peroxide oxidation (60°C, 70°C), Fenton’s reagent, NaOH (1 M, 10 M) and KOH. The methods testing procedure was split into three phases: 1. Effect of reagents on test polymers; 2. Efficacy of reagents in reducing organic matter content in soil and sludge; and 3. Extraction efficiency for this protocol. This analysis of time- and cost-effective approach suitable for application in routine monitoring of complex environmental substrates whilst facilitating the collection of important particle information.

222 Mapping microplastics in sludge during a country-wide investigation of wastewater and sludge treatment plants A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; R. Hurley, NAvige Institute for water research; M. Olsen, C. Vogelsang, NIVA Norwegian Institute for Water Research Incorporation of anthropogenic particles into sludge has been highlighted as a major route for the transport of pollutants into the environment. Here we present the results of a country wide survey investigating the incorporation of microparticles into sludge from domestic wastewater treatment plants which operate different waste water and sludge treatment technologies. The main objective of this project was to characterize, map and compare results between different types of wastewater treatment plants. Particles were extracted using organic matter removal followed by a density separation procedure following. Plastics were identified in sludge samples from all treatment plants investigated. The overall average microplastics concentration was 6 077 particles kg⁻¹ (d.w.) (1701 – 19 837) or 1 176 889 particles m⁻³ (470 270 – 3 394 274). Particles from sludge consisted of beads (37.6%), fragments (31.8%) fibres (28.9 %) and glitter (1.7 %). Most of the particles were clear in colour (41%). Ten percent of the overall particles extracted were tested using FT-IR. All particles (n= 80) were confirmed to be plastics. Polyethylene terephthalate (PET) (26.7%) and polypropylene (20.3%) 62% of plastics were extracted during the low density (1 g cm⁻³) separation step and 38% were extracted at high density (1.8 g cm⁻3). Results between WWTs were highly variable and there was no clear difference between average microplastic concentrations across the different treatment technologies. Based on this study and details on the application of sewage sludge in Norway, it can be estimated that approximately 446 billion microplastic particles are spread on agricultural soils, 27 billion microplastic particles are added to green areas and 112 billion microplastic particles are sent to soil producers per year. This equates to over 584 billion microplastics that are released into the environment via sewage sludge application each year in Norway.

223 The Influence of Weathering on the Sinking Behavior of Microplastic in Freshwater and all Surface Waters H. Arg, NGI / Environmental Technology; L.B. Olsen, D. Issler, NGI; N. Berrogård, NGI / Environmental Chemistry; S. Wongsorejo, X. Shen, E. Toormann, KULeuven Key to understanding the fate of microplastic particles in freshwater are the changes they undergo as a result of various weathering processes, like biofilm growth, aggregation, UV exposure and physical stress. Some of these weathering
processes may cause changes in the density and shape of individual plastic particles, or aggregates. This can be a driving factor for the ultimate fate of microplastic, as it could cause floating microplastic to sink or be suspended below the water surface. However, the factors controlling the buoyancy or sinking velocity of different microplastic are not as well-known as they are for other particles/particulates, like phytoplankton and sedimentary material. Herein we present the results of linking experiments between microplastic, covering different shapes (spheres, fish and irregular), microplastic batches intermixed with freshwater and saline waters, considering a range of ambient conditions (temperature, salinity and turbulence). The microplastic were compared before and after exposure to weathering processes in the lab and outdoors. The results obtained in this sinking experiment were compared to theoretical expectations, based on literature equations that describe the relationship between the drag coefficient and particle Reynolds number. A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline waters alike, as it would to all types of microplastic.

Air Pollution, Biomonitoring and Human Health (I)

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Particulate matter in indoor academic environments: chemical composition, sources, infiltration from outdoor
L. Tofail, CNR / Institute of Atmospheric Pollution Research; S. Canepari, Sapienza University of Rome / Chemistry; M. Catrambone, F. Marcocciuco, M. Giusto, CNR / Institute of Atmospheric Pollution Research; S. Paret, CNR / institute of atmospheric pollution research; T. Sargolini, CNR / Institute of Atmospheric Pollution Research; E. Perrino, CNR Institute of Atmospheric Pollution Research / Institute of Atmospheric Pollution Research
We present the results of the first part of an experimental study carried out in an number of academic environments, ranging from small laboratories to very wide classrooms. The study was aimed to evaluate the mass concentration and the chemical composition of indoor atmospheric particulate matter (PM_{2.5} and PM_{10}) and its relationship with a number of parameters. These include: concentration and chemical composition of outdoor particles, mixing properties of the lower outdoor atmosphere, volume and floor of the classroom, distance from the street, presence/absence of the students, season. Two type of sampling schedules were applied. The first one differentiates among working days, nights and week-ends during a 6-week winter period and a 4-week summer period (Special Observation Periods – SOPs). This schedule was planned to highlight the differences due to the presence of the students and teachers. The second one (Long-Term Sampling) consists in twelve 1-month PM_{2.5} samplings carried out by using very-low flow-rate samplers. It was envisaged to obtain a general picture of the effect of the above parameters during a whole calendar year. Both sampling schedules were applied to six indoor and four outdoor sites, all inside or around the same building. At each site and for both schedules the sampling were simultaneously carried out on Teflon, quartz and polycarbonate filters. Teflon filters were used for the determination of the collected mass (by gravimetry), of the elemental content (total content by energy dispersion X-ray fluorescence, bioavailable and residual fractions by inductively coupled plasma mass spectrometry), of anions and cations (by ion chromatography), of elemental and organic carbon (by thermo-optical analysis) and of the bioaerosol content (by propidium iodide staining and epifluorescence microscopy). The bioaerosol was sampled by using a commercial fixed food source. The calculated concentrations for all these food categories were matched to Belgian consumption data in order to calculate dietary exposure. Estimation of the contribution of deposition in the overall exposure was done by comparing a baseline exposure scenario based on recent atmospheric measurement data with a scenario where dry and wet deposition fluxes were arbitrarily set to zero. Save deposition reference values were derived by comparing the calculated overall exposure for the baseline scenario with the oral Tolerable Daily Intake (TDI). In case of exceedance, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were ran for 16 priority EPA - PAHs and benzo(a)pyrene exceeded the TDI with a factor 4, implying that current deposition rates might be too high. More deposition measurement data for B(a)P are required to confirm these results. The authors thank the Flemish Agency for Health and Care for their support.

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Source apportionment of major species and metals in PM_{2.5} in urban sites under industrial influences in northern France
F. Ledoux, University of Littoral Côte d’Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492; A. Kfoury, University of BALAMAND / Department of Environmental Sciences; G. Delmaire, University of Littoral Côte d’Opale / Laboratoire Informatique Signal de la Côte d’Opale LISIC EA4491; G. Rosselin, Université Lille 1 / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492
PM_{2.5} have been related to various adverse health effects, mainly due to their ability to penetrate deeply and to convey harmful chemical components inside the body. The North of France is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metallurgy, organic chemistry, and glassmaking. Furthermore, its strategic position in the heart of Europe means that this area is subject to major transportation activities by road and also by sea. In this context, the objective of this work was to acquire a better knowledge on the exposure level to major species and metals in PM_{2.5} and on the identification of their sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using DiGietal® DA80 high volume samplers between november 2010 and april 2011 in three medium cities located in northern France, Dunkerque (Dk, coastal urban and industrial site), Boulogne-sur-Mer (BL, coastal and urban site) and Saint-Omer (SIo, inland urban and industrial site). PM_{2.5} composition was analyzed for major elements, trace elements, and their species. The laboratory analysis was directed, respectively. Species concentrations were examined according to different ways including temporal evolution, concentration and pollution roses.. The impact of such sources on major species and metal concentrations in PM_{2.5} was then quantified using a weighted non-negative matrix factorization based receptor model that considers constraints on chemical profiles (CW-NMF). NO\textsubscript{2}, SO\textsubscript{4}\textsuperscript{2-}, NH\textsubscript{4}+ and TC were found as the major contributors of PM\textsubscript{2.5} (between 95% and 99%) and some differential differences were evidenced. Trace elements (Cr, Zn, Ni, As, Ag, Cd, Cu, Mn, Pb, V, Sn, Rb, Sr, Bi, Ba, Co, Sb and Ti) only correspond to 0.30% to 0.45% of the PM\textsubscript{2.5} mass according to the sites. The CW-NMF model identified 8 common source profiles at the 3 sites: secondary nitrates, residential and road traffic, secondary sulfates, fresh and aged sea-salts, heavy fuel oil combustion, non-exhaust traffic and crustal. In addition, 4 industrial source profiles were identified in Dk and semi-industrial emissions and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM\textsubscript{2.5}, such industrial sources were the main contributors of metals at the two sites.

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Estimating the contribution of deposition in the total exposure to PAH’s in order to derive save deposition reference values
J. Bierkens, VITO / Sustainable Health; L. Geerts, M. Van Holderbeke, VITO NV; K. De Brouwere, VITO NV / Health; A. Standaert, VITO; C. Cornelis, VITO / Environmental Risk and Health; T. Fiennes, VITO
Partitioning of PAHs between the particulate and the gaseous phases strongly influences their fate and transport in the atmosphere and human exposure. Dry and wet deposition processes are major sources for PAHs in soil and crops. Our aim was to determine the proportion of the overall burden of environmental and dietary exposure to PAHs that is attributable to deposition in order to derive save deposition reference values. To this end, the fate and human exposure was modelled using the MERLIN-Expo, a software tool that allows to model lifetime exposure, integrating exposure through multiple pathways. Model simulations were based on recent year average concentrations in air and particulate matter (PM\textsubscript{2.5}) in Belgium. The conceptual model implemented, included inhalation, soil and dust ingestion as well as dietary exposure via the consumption of vegetables, meat and dairy products. Toddlers were chosen as the receptor as they are considered a vulnerable group. Dietary exposure to PAHs via crops was modelled using a plant uptake model representing leafy vegetables, fruits and grain, respectively. A cattle model taking its inputs from a grass and maize model was used to calculate concentrations in meat and dairy products. Concentrations in fish were modelled as an external fixed food source. The calculated concentrations for all these food categories were matched to Belgian consumption data in order to calculate dietary exposure. Estimation of the contribution of deposition in the overall exposure was done by comparing a baseline exposure scenario based on recent atmospheric measurement data with a scenario where dry and wet deposition fluxes were arbitrarily set to zero. Save deposition reference values were derived by comparing the calculated overall exposure for the baseline scenario with the oral Tolerable Daily Intake (TDI). In case of exceedence, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were ran for 16 priority EPA - PAHs and benzo(a)pyrene exceeded the TDI with a factor 4, implying that current deposition rates might be too high. More deposition measurement data for B(a)P are required to confirm these results. The authors thank the Flemish Agency for Health and Care for their support.

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A bioassay-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air matrix contamination level
S. Loriboe, IBIPE; E. Moreau-Guigné, IPIPE, PSL / UMR METIS; F. Alliot, IPIPE / UMR Metis; B. Bimbou, Univ. Paris-Sud / UMR ESE; A. Desportes, EPHE / UMR METIS; V. Huteau, Univ. Paris-Sud / UMR ESE; M. Chevreuil, IPIPE / UMR METIS 7619; L. Ozio, University of Paris-Sud / UMR CINS 8079
Air quality is currently assessed by monitoring a few pollutants involved in the assessment of several health endpoints. However, it is necessary to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposure to many bioactive micropollutants, which can also interact with each other. In this way, in vitro bioassays might be relevant biomonitoring tools to assess the air quality, as they integrate these “cocktail” effects. Furthermore, the pulmonary exposure to semi-volatile endocrine-disrupting compounds (EDCs) may cause hormonal disruptions observed in humans, especially indoors where they spend 80% of their time. By using cellular bioassays, we have previously shown that bioactive EDCs tend to concentrate indoors, especially in the gaseous phase. The concomitant chemical analysis of a wide range

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of EDCs led to the same conclusions, except in cold season during which the indoor gaseous phase concentrated fewer target EDCs than in summer along with gaseous phase concentrated fewer target EDCs than in summer along with gaseous phase. The heterogeneity in ventilation type deteriorating and aged mechanical systems had on indoor air quality was distinct; the half maximal efficacy measured by transactivation cellular assay). After applying the same cellulose acetate membranes for the biological preparation of the initial organic extract into two compartments (concentration level, intrinsic estrogenicity, lipophilicity), major families found indoors (phthalates, synthetic musks, alkylphenols, parabens) stood out as playing a role in the estrogenicity of the gaseous phase, especially the lead compounds butylbenzylphthalate, galaxolide, butyl-paraben and nonylophenol. The data suggest however the involvement of non-studied EDCs in this biological effect. Our data confirm that bioassays represent suitable biomonitoring tools to assess air quality, whether they are associated with the chemical analysis or not. Terni basin, which limit the dispersion and enhance the accumulation of atmospheric pollutants, are ideal to test and validate new experimental methods for the acquisition of spatially-resolved data.

The added value of using invertebrate species in ecotoxicology: new insights for environmental risk assessment (I)

230 Transgenerational effects of a parental exposure in the sentinel species Gammarus fossarum

P. Ciribu, ENTEPE, IRSTEA Lyon; A. Devaux, INRA-CNRS / UMR LEHNA USC INRA IGH ENTEPE; K. Abbacci, H. QUEAU, N. Delorme, L. Garnier, IRSTEA Lyon. UR MALY Laboratoire Ecotoxicologie; S. BONY, INRA - CNRS / UMR LEHNA USC INRA IGH ENTEPE; a. chaumont, IRSTEA / UR MALY Laboratoire Ecotoxicologie

Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that unequivocally link biomarker responses to fitness impacts and finally to population level are scarce (1). This is mainly due to the discordance in time scales between toxicological and ecological responses. In previous laboratory studies exploring the effects of high contamination levels of single molecules, a relationship has been established between genotoxic impacts in gametes of the sentinel species Gammarus fossarum, and impairment in embryo production. However, such a link was not observed after exposure to complex mixtures in the field at more environmentally realistic concentrations (2). Taking advantage of the availability of biomass measured in multiple scale in this species, from the molecular level (primary DNA damage, global DNA methylation) to physiological one (feeding rate, molting success, vitellogenesis) and life history traits (growth, fertility, embryonic survival), along with the possibility to conduct rearing culture in the lab (time to puberty about 4 months), the objective of this study was to assess whether biomarker responses revealed in adult gammarids exposed to a chemical stress could be predictive of the fitness of their progeny (i.e. transgenerational effects). For this, the consequences of an exposure in the lab of genitors to environmentally relevant concentrations of cadmium were evaluated in F1 and F2 individuals reared in uncontaminated conditions. In complement, a field exposure experiment through in situ caging of the adult F0 followed by the assessment of the subsequent effects in F1 and F2 progeny was performed (1). Results (1) Forbes VE, Calow P, Sibly RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994, (2) Lacaze E, Geffard O, Geyot D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cells with reproduction impairment, using the Comet assay. Environmental Research111:626-634

231 Species differences of bioaccumulation, biotransformation and synergistic effects of two fungicides in two aquatic invertebrates

Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; A. Rösch, Eawag / Environmental Biology; c. perrino, CNR Institute of Atmospheric Pollution Research / Institute of Atmospheric Pollution Research; M. Costa, Sapienza University of Rome; S. Canepari, Sapienza University of Rome / Chemistry

A new very-low volume sampler has been developed with the purpose of allowing spatially-resolved determination of atmospheric particulate matter (PM) and its chemical components. The low-cost, automatic and self-powered device assures long-term (1-2 months) collection of PM on membrane filters, suitable for subsequent chemical analysis. The device was validated during a 2 months campaign focused on the concentration of PM2.5 mass, ions, levoglucosane, polycyclic aromatic hydrocarbons (PAH) and elements. It showed very good performance in terms of repeatability of the samplings, which is the essential characteristic to build a reliable network. The samplers have been employed, for the first time, to evaluate the spatial variability of PM2.5 mass concentration and its main chemical components in the area of Terni (a urban/industrial hot-spot site in an intramountain depression of Central Italy). Lichen transplants have been exposed at the same sites of the samplers in order to evaluate the potential of lichens as biomonitor for PM spatially resolved analyses. The meteorological conditions of

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and H. azteca, respectively. The LC50 of oxastrobin alone were 157 and 200 µg L−1 in G. pulex and H. azteca, respectively. Prochloraz significantly decreased the LC50 of oxastrobin in both species. Video-tracking of the locomotory behavior suggested that prochloraz induced hyperactivity in G. pulex, but not in H. azteca. Overall, results suggests H. azteca comprise more diverse biotransformation reactions and G. pulex tended to be more sensitive than H. azteca toward prochloraz effects.

232 Use of Gammarus sp. for toxicity testing. A case study with the growth regulator insecticide fenoxycarb, H. Arambourou, I. Rieste Lyon / Freshwater system, Ecology and Pollution Research Unit / IR MALY; J. Riaud, Institute Ecotoxicology; N. Delorme, K. Abbaci, I. Rieste Lyon / UR MALY; P. Nourry, I. Rieste Lyon / Ecotoxicology; R. Tuttunjian, I. Rieste Lyon; E. Vulliet, Institute of Analytical Sciences; G. Daniele, ISA / Biology; C. Barata, CSIC / Environmental Chemistry; I. Fuerbes, Institute of Environmental Assessment and Water Research (IADEA) CSIC; V. Debat, MNHN / Institute of Systematic, Evolution and Biodiversity.

Gammarus sp. (Amphipoda) are widely distributed across European freshwater systems. In the present study, we evaluated the effect of a fenoxycarb exposure on Gammarus sp. More specifically, i) we assessed the sensitivity of the embryo stage, ii) we identified embryogenesis’ sensitive period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among three European gammarid species. Fenoxycarb is a growth regulator insecticide, analog of the insect juvenile hormone, used for pest management and for veterinary purpose. This study demonstrated that 5 and 50 µg L−1 fenoxycarb can alter embryonic development of G. fossarum. The gastrulation phase was particularly sensitive. Moreover, exposure to 5 and 50 µg L−1 fenoxycarb strongly altered the pre-copulatory behavior in G. fossarum and a 50 µg L−1 exposure prevented the production of viable embryos. These results highlighted the deleterious effects of the insect growth regulator fenoxycarb on gammarid embryogenesis and reproduction, which could have severe repercussions on population dynamics. The response to the toxic exposure was dependent on the study gammarid species which underlined the importance to consider species with broader phylogenetic representation to better assess insect growth regulator effects.

233 Adaptation of Gammarus pulex to agricultural insecticide contamination in streams, N. Shahrd, Helmholtz Centre for Environmental Research UFZ; J.M. Becker, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology.

Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the toxicity of pesticides. However, it is not known under which conditions adaptation occurs when only a low toxic pressure from pesticides is present. Here, we show that Gammarus pulex, a dominant macroinvertebrate species in many agricultural streams, acquires increased tolerance to pesticides when re-colonization from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below the considered effective concentrations showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC50 218 ± 11 µg L−1) compared with non-exposed populations (mean EC50 81 ± 11 µg L−1). This tolerance of exposed populations increased from 2- to 4-fold with increasing distance to the next recovery site (0 to 10 km). We conclude that the development of tolerance for non-target species may occur at very low concentrations, much below those predicted to be safe by governmental risk assessment frameworks.

234 The use of antifouling bioicides in a changing world: combined impact of multiple exposure to pesticides and other emerging pollutants, A. Robinson1, Centre for Ecology & Hydrology; E. Lahive, Centre for Ecology and Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgeon, Centre for Ecology & Hydrology.

We investigated the response of the filter feeder, Daphnia pulex, to fenoxycarb, a growth regulator insecticide, analog of the insect juvenile hormone, used for pest management and for veterinary purpose. This study demonstrated that 5 and 50 µg L−1 fenoxycarb can alter embryonic development of G. fossarum. The gastrulation phase was particularly sensitive. Moreover, exposure to 5 and 50 µg L−1 fenoxycarb strongly altered the pre-copulatory behavior in G. fossarum and a 50 µg L−1 exposure prevented the production of viable embryos. These results highlighted the deleterious effects of the insect growth regulator fenoxycarb on gammarid embryogenesis and reproduction, which could have severe repercussions on population dynamics. The response to the toxic exposure was dependent on the study gammarid species which underlined the importance to consider species with broader phylogenetic representation to better assess insect growth regulator effects.

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (I)

236 Multiple exposure to pesticides and other emerging pollutants – problems and solutions for healthy ecosystems and humans, M. Santen, G. Ungherose, Greenpeace.

Industrial pollution is a severe threat to water resources around the world, particularly in the Global South factories release hazardous chemicals that impact our precious water resources - causing long term devastation to human health and the environment. Rivers supply vital resources, including drinking water, crop irrigation and food. Therefore, water pollution is of critical concern for society. In the past decades Greenpeace did several investigations on persistent chemicals like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system highly dependent on synthetic-chemical pesticides doesn’t come without consequences. The impacts of industrial agriculture like Apple and fruit production are widespread, ranging from contaminated soil and water, to impacts on bees and other beneficial insects, as well as on farmers, their families and consumers. Starting in 2011 investigations in the

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Industrial pollution is a severe threat to water resources around the world, particularly in the Global South factories release hazardous chemicals that impact our precious water resources - causing long term devastation to human health and the environment. Rivers supply vital resources, including drinking water, crop irrigation and food. Therefore, water pollution is of critical concern for society. In the past decades Greenpeace did several investigations on persistent chemicals like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system highly dependent on synthetic-chemical pesticides doesn’t come without consequences. The impacts of industrial agriculture like Apple and fruit production are widespread, ranging from contaminated soil and water, to impacts on bees and other beneficial insects, as well as on farmers, their families and consumers. Starting in 2011 investigations in the
context of Greenpeace’s detox campaign have found a wide range of hazardous substances in the waste waters of textile production or in the effluent of communal wastewater treatment plants (WWTPs) from industrial zones in China, as well as in nearby rivers. Case Studies on per- and polyfluorinated chemicals show that PFAS (perfluorinated alkyl substances) are widespread compounds of environmental concern. Because of their well-recognized hazardous properties, long chain PFASs have been subject to increasing regulation. In 2015 Greenpeace conducted an unexpected search in remote areas; snow and lake water samples were taken at 10 remote high altitude sites showing that these persistent chemicals are present everywhere on the planet. In 2017 Greenpeace Italy carried out PFAS analysis in wastewaters, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountain. It is not too late to act – but new rules and regulations are required. The use of pollution prevention control or wastewater treatment does not deal effectively with all hazardous substances, and only postpones the need for more effective measures. The problem has to be tackled at its source. The Detox campaign challenges top textile brands to work with their suppliers and eliminate PFAS and other all hazardous chemicals across their entire supply chain, and the entire life-cycle of their products. The growing concern about Europe’s massive pesticide use goes hand in hand with an increasing need to search for ecological solutions. To be effective, action needs to be based on knowledge, which requires transparency as a first step, the quantities of hazardous substances used and discharged to be reported and monitored, with full availability of data to the public. [1] http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fresh%20Deciduous%20Fruit%20Annual_Vienna_EU_27-10-2011.pdf [1] http://www.greenpeace.org/italiano/Global/international/publications/toxics/Water%202011/01-dirty-laundry-12-pages.pdf [1] https://www.greenpeace.de/sites/www.greenpeace.de/files/20121203-Toxic-Threats-China-eng.pdf [suppl.] Greenpeace (2015), Footprints in the Snow; http://detoxfootprint.org/assets/uploads/Reports/2012/AR2_Report_06_2015_en.pdf [suppl.] Greenpeace (2017) Pits in Veneto: inquinamento sotto controllo? (in italian) [1] http://www.greenpeace.org/italy/Global/italy/report/2017/Inquinamento/PFAS-in-Veneto.pdf [suppl.] Greenpeace (2017) Non ce la beviamo. Presenza di PFAS nell’acqua delle scuole venete (in italian) [1] http://www.greenpeace.org/italy/Global/italy/report/2017/Inquinamento/Report_Non_ce_la_beviamo.pdf

237 Benefits of international Science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework
A. van Wezel, KWR Watercycle Research Institute / Environment and Health; S. Rinck-Pfeiffer, Global Water Research Coalition; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; F.D. Leusch, Griffith University / Australian Rivers Institute; P.A. Neale, Griffith University / Centre for Environmental Research GmbH; M. Dingemans, KWR Watercycle Research Institute / Chemical Water Quality and Health; M. Dinergans, KWR Watercycle Research Institute; M. Meeker, Water Environment & Reuse Foundation (WE&RF); Bioanalytical tools hold great promise as an additional tool of our current water monitoring strategies. In vitro bioassays, which are increasingly being applied in water quality assessment, provide relevant and robust predictive biosystems able to specifically and quantitatively measure early adverse effects of contaminants in water, including providing a measure of mixture effect, even in low doses, where individual compounds may not be sufficient to contribute to the toxicity. These tests can be used for safety of conventional water treatment plants and be integrated in future regulations. They also could provide robust monitoring frameworks to promote alternative water schemes as promoted by the Blue Print Initiative in Europe to better safeguard water resources and the WHO Potable Reuse Guidance document. While leading players in Australia, Europe and US recommend to incorporate predictive tools to regulate PFAS chemicals, Australia, US (CA), Canada, RIVM, EAWAG, KWR, UFZ, EU-JRC and EU DG-Env, WHO and GWRC), these bioanalytical tools need to be more comprehensively validated and benchmarked across the entire water cycle and against human and ecological health outcomes before they can be adopted in regulatory frameworks. A critical next step will be to derive further EBT for an expanded scope of bioassay endpoints. Several strategies for the derivation of EBT have been proposed but there remains a lack of acceptance and harmonization across the field to allow better acceptance of these innovative water quality and safety frameworks. Covering a wide range of issues including water quality and quantity management and the management of water-related risks, the OECD is endeavouring to capture science as policy recommendations that derive from its past and recent work on water in a single, consistent and action-oriented policy. By hosting a collaborative task-force or expert working group including GWRC experts and gathering international organizations such as WHO, UNESCO and the OECD we can get to benchmark these new effect-based trigger values, and contribute to the water challenge by targeting Water effect-based guidelines. Complementary tasks could be to support new OECD Science to Policy interface as a supportive action to better explain and disseminate the associated benefits for stakeholders as citizen towards their health protection, municipalities and local authorities, water professionals and institutional bodies.

238 Chemicals of emerging concern (CEC) in the water cycle – a regulatory perspective
M. Helmcke, Umweltbundesamt (UBA)
Environmental authorities increasingly need to address the challenge of contaminants of emerging concerns found in the water cycle. The German Environmental Agency has assessed entry paths, critical hotspots of chemicals and the existing legislation to derive potential measures to minimize micro-pollutants in the aquatic environment. A holistic and precautionary approach is needed that combines measures at the source, during the usage of products and chemicals as well as end-of-pipe measures. The EU Water Framework Directive and the Marine Strategy Framework Directive pose a legal frame to achievegood performance of waterbodies. To overcome chemical fate, transport and effects on the environment far beyond the current 45 “priority pollutants” or even “known” chemicals. Open science and the exchange of information (between for example scientists and regulatory authorities) has a critical role to play in the continuing evolution of NT. Using a variety of case studies from Europe, this talk will highlight how open science activities such as MassBank.EU (https://massbank.eu), the European Network of Environmental Authorities (http://www.norman-network.com/?page=236) and NORMAN Digital Sampling Freezing Platform (http://norman-data.eu) as well as the US EPA CompTox Chemistry Dashboard (https://comptox.epa.gov/dashboard/) can support NT. Further, it will show how initiatives such as near “real time” monitoring of the River Rhine and retrospective screening via so-called “digital freezing” platforms have opened up new potential for exploring the dynamics and distribution even in as-yet-undefined chemicals. Collaborative European and international activities facilitate data exchange amongst analytical data scientists and enable quick, effective and reproducible provisional compound identification in digitally archived HR-MS data. This is leading to new ways of assessing and prioritizing the new generation of “emerging pollutants” in the environment, enabling a pro-active approach to environmental protection, possibly unthinkable only a few years ago. Note: This abstruct does not reflect US EPA policy.

240 Toxicological profiling of water samples with in vitro bioassays and assessment using effect-based triggers (EBTs)
B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; R. Altenburger, UFZ Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Alt-Allisa, Institut National de l’Environnement Industriel et des Risques (INERIS); P.A. Behnisch, Biodetection Systems BV; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; F. Brison, INERIS / Ecotoxicology Unit; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; W. Busch, Helmholtz Centre for Environmental Research - UFZ GmbH / Bioanalytical Ecotoxicology; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research,
Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations

241 Chemical gene interactions for associating contaminants with biological effects

A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; D. Martinovic-Weigelt, University of St. Thomas / Biology; G.T. Ankley, D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory

Evaluating the potential human health and ecological risks associated with exposures to complex chemical mixtures in the environment is one of the main challenges of chemical safety assessment and environmental protection. There is a need for approaches capable of integrating chemical monitoring and biological effects into the assessment of complex chemical mixtures present in the environment. We will present an approach that uses prior knowledge regarding the biological effects of individual contaminants to predict toxicity of mixtures and prioritize contaminants. More specifically, we use chemical-gene interactions networks to develop knowledge assembly models (KAMs; which is specific to the aquatic system of interest) based on chemical monitoring data and publically available chemical-gene interaction data. When only chemical data are available, KAMs allow for the development of site-specific hypotheses for follow-up biological effects testing. When transcriptomics data are available, KAMs can be used with statistical approaches, such as reverse causial reasoning approaches to prioritize risk and contaminants. Two brief examples using chemical-gene interactions and KAMs will be presented. The first example used chemical monitoring-data from the effluent of a local wastewater treatment plant (WWT) to develop chemical-gene interaction networks. The networks were used to develop hypotheses about the biological effects of the effluent. To test the network predictions, targeted gene expression, using quantitative polymerase chain reaction, was measured from adult male and female fathead minnows that were exposed to the effluent. The second example used prior knowledge about chemical-gene interactions to develop a KAM for detected chemicals at five locations near two WWTs. Hepatic transcriptome data from fathead minnows exposed to site-water at each location were mapped to the assembly models to evaluate the likelihood of a chemical contributing to the observed biological responses using richness and concordance statistics. The use of chemical-gene interaction networks and KAMs have strong potential for associating chemical occurrence data to biological effects that, when integrated with adverse outcome pathway knowledge, can guide research and/or monitoring efforts related to the effects of contaminants in the environment. The contents of this abstract neither constitute nor necessarily represent official US EPA views and policies.

242 The triazole story: Clarification of sources, fate and footprint in the environment of the molecule 1,2,4-triazole

M. Blank, Bayer AG Crop Science Division / Environmental Safety; B. Harvey, Syngenta; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; D. Liss, SGS Institut Fresenius GmbH / Agro

1H-1,2,4-Triazole (124T) is a key structural component of azole-fungicides, one of the world’s most widely used fungicide classes in agriculture. To develop protection industry taskforce (Triazole Derivative Metabolite Group, TDMG) is jointly addressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, toxicology, and risk assessment of 124T. So far in the regulation of crop protection its origin was interpreted as a result of the breakdown of the parent azole-fungicides only. 124T is toxicologically classified as R63. According to the EU Regulation, Directive 1107/2009, it is a ‘relevant’ metabolite in groundwater and subject to a legal maximum concentration of 0.1 µg/l with respect to crop protection uses. Distinct restrictions on agricultural uses of azole-fungicides have been necessary to meet this hazard based limit value. In response to the large number and widespread use in the EU of registered azole products, regulatory authorities are asking for information about 124T’s potential leaching and actual contributions in groundwater. The TDMG scientists discovered that 124T occurs ubiquitously in the environment, originating also from other anthropogenic sources than azole-fungicides, such as fertilizer additives (to avoid nitrate leaching) and commodity chemicals, and is also naturally formed. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches were needed. The TDMG scientists have therefore extended their scientific scope into non-agricultural environments and residues in different matrices. The work is supported with a recent terrestrial field dissipation study using a 13C stable isotope labelled azole-fungicide to enable differentiation between the different sources, a forest soil study to assess the background abundance of 124T in non-agricultural soils, and several groundwater monitoring studies. This work has confirmed the wide range of sources of 124T and showed that it is not currently nor possible to distinguish between their contributions to measured environmental concentrations. Consequently, relying on azole-fungicides as the only source of 124T-concentrations could result in a systematic over-estimation of the environmental exposure risk from pesticide usage. An improved understanding of the sources of the molecule in the environment is a pre-requisite for reliable and justified regulatory conclusions.

243 The triazole story: Assessment of the background abundance of 1H-1,2,4-triazole in selected German forest soils

M. Blank, Bayer AG Crop Science Division / Environmental Safety; H. Borchers, A. Chloubo, Bayer Crop Science; G. Telschow, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; O. Heinemann, Bayer AG Crop Science Division

1H-1,2,4-Triazole (124T) is an ubiquitous small molecule which originates from different anthropogenic sources in the environment or from biotic or abiotic degradation of triazole-fungicides. In addition, 124T potentially originates from natural sources like soil microorganisms (Fungi, Actinomycetes). Information about the natural background abundance of 124T in forest top soils of German origin is of importance for the assessment of the entry paths and occurrence levels into the environment by crop protection measures. In a GLP terrestrial field study, duplicate forest top soil samples from ten different locations and different forest types (beech, spruce, pine, oak) in Germany were sampled in 2012/2013 for analytical investigation of the 124T background. For this reason, remote areas without close contacts to agricultural areas were selected. In addition, at two of these sites the development of the 124T residue background level was investigated over the period of one year. The background abundance of 124T in the samples ranged from < 1.0 to 1.9 µg/kg in oak forest top soils, from 1.0 to 2.1 µg/kg in pine forest top soils, and from < 1.0 to 1.2 µg/kg in spruce forest top soils. In the selected beech forest top soils the background abundance of 124T was below 1.0 µg/kg. The background abundance of 124T in beech and spruce top soil samples taken from April 2012 to February 2013 showed fluctuations over time. These variations could not be associated to seasonal changes. Single values ranged from < 1.0 to 1.8 µg/kg in the beech top soil samples and from < 1.0 to 2.1 µg/kg in the spruce top soil samples. Overall, a background abundance of 124T could be detected in all forest top soils sampled in Germany. Anthropogenic 124T sources (e.g. fertilizer additives, metabolites of triazole-fungicides, breakdown product of commodity chemicals) could be excluded. This indicates that the measured 124T residues originate from natural sources in the environment.
Challenges of a groundwater monitoring study design for a substance with multiple sources: determining risk for groundwater from 1,2,4-Triazole formed from fungicides used in arable crops in Germany

H. Harvey, Syngenta; M. Blank, Bayer AG Crop Science Division / Environmental Safety; B. Brumhard, Syngenta Agro GmbH / Registration; P. Edwards, Syngenta Ltd.; A. Kaane, Bayer AG Crop Science Division; L. Liss, SGS Institut Fresenius GmbH / Agriculture; H. Resseler, Syngenta Agro GmbH; M. Schneider, SGS Institut Fresenius GmbH; H. Staudenmaier, BASF SE / Crop Protection, Environmental Fate

1H-1,2,4-Triazole (124T) is a widely occurring molecule with a number of anthropogenic sources, but also biogenic sources, all of which may result in the presence in the groundwater. The regulatory framework under which potential risks to environment and health are assessed, including applicable trigger concentrations, depends on the source. As a metabolite of triazole fungicides used in agriculture, 124T is regulated under EU Regulation 1107/2009 and subject to a regulatory trigger concentration of 0.1 µg/L in groundwater. At the same time, 124T is also used in agriculture as a nitrification inhibitor added to mineral fertilizer or slurry, making this a potential additional source contributing to overall soil load. The risk to groundwater from this use is however assessed under other regulations.

To address regulatory concerns about the leaching risk for 124T from combinations of triazole fungicides used in agricultural practise, the industry group TDMG has conducted groundwater monitoring studies in Germany. As the aim was to evaluate the risk from triazole fungicides only, the challenge was to design studies to sample groundwater originating in areas with intensive triazole fungicide usage, while where applications of 124T-containing fertiliser and other potential sources could be reasonably ruled out. Existing wells from authorities’ or water producer’s monitoring networks were sampled in the studies, thus capturing a range of scenarios for leaching risk in real-world agricultural practice. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitability. This involved interviews to document relevant product applications and rule out use of 124T-containing fertilizer in the upstream area. In total 211 groundwater samples from 31 wells in different regions of Germany were analysed. All samples were < 0.1 µg/L, with 14 samples between 0.05 (±LOQ) and 0.08 µg/L. The results show that even with intensive use of triazole fungicides, the concentrations of 124T in shallow groundwater downstream from treated fields did not exceed the regulatory trigger of 0.1 µg/L. The presented approach is considered to be effective to obtain a realistic picture of groundwater exposure to 124T from triazole fungicides in agricultural practice. Ruling out other sources is challenging, but possible with site screening and engagement with the farmers.

247 Overlooked sources of trifluoroacetate in the water cycle - consequences for drinking water supply and regulatory measures

K. Nödler, TZW DVGW-Technologiezentrum Wasser / Analysis and Water Quality department; M. Scheurer, DVGW Water Technology Center / Analysis and Water Quality; P. F. Freeleg, DVGW Water Technology Center; J. Janda, O. Hoppel, F. Lange, H. Brauch, DVGW Water Technology Center / Analysis and Water Quality

Relevant amounts of trifluoroacetic acid (TFAA) are formed in the atmosphere by photochemical transformation of several refrigerants and subsequently introduced into the aquatic environment by wet deposition. TFAA occurs as trifluoroacetate (TFA) in the aquatic environment and is considered to be persistent and mobile. Both the acid and its potassium salt are manufactured and/or imported in large amounts in the European Union (Fricker et al., 2007). TFAA is a persistent and bioaccumulative degradation product of several pesticides. During a screening of surface waters in south-west Germany, high concentrations of TFA (up to 140 µg/L in a tributary of the River Rhine) were detected. As a consequence, concentrations of TFA at adjacent bank filtration sites and tap waters were also substantially elevated. The here presented study aims on source identification as well as on the assessment of treatment options (ozonation, chlorination, activated carbon filtration) for contaminated raw waters. Ozonation of model substances and wastewater samples was applied to reveal the TFA-forming potential of individual compounds and the presence of not yet identified TFA-precursors in waters bodies in general. Discharge of industrial wastewater was identified as the source of elevated concentrations of TFA in the Rhine tributary. Extended monitoring demonstrated that this contribution still impairs the drinking water supply along the lower River Rhine. Ozonation, activated carbon filtration, and chlorination do not allow for considerable removal of TFA. Monitoring of wastewater treatment plants (WWTP) demonstrated that WWTP also emit TFA. One WWTP showed substantial formation of TFA and ozonation of WWTP-outflows led to increasing concentrations. Tests on the formation of TFA by ozonation of the selected potential precursors demonstrated highly compound-specific TFA-yields between insignificant and ~40%. Sources and pathways of TFA may still hold hidden. As contaminated water resources cannot be efficiently treated by technical options typically applied in water utilities, this topic needs to be addressed for sustainable water management. Small molecules such as TFA may originate from different sources and their individual contributions may be subject of temporal and spatial variability. This must be taken into account with regard to risk assessment as well as for the regulation and authorization of chemicals.

Persistence & Biodegradation Assessment

248 Why biodegradable chemicals persist in the environment? A look at bioavailability

J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica y Conservación del Suelo

The biodegradability of a given chemical in the in the environment cannot be assessed properly without considering the chemical’s bioavailability to the degrading microbial populations. This is especially applicable to hydrophobic organic chemicals (HOCs), like polycyclic aromatic hydrocarbons (PAHs). With the aim of providing pathways for implementation into regulatory contexts, this
overview contribution will examine the range of techniques and experimental models suitable for the assessment of HOCs biodegradability taking into account state-of-the-art bioavailability science (Environ. Sci. Technol. 49:10255-10264, 2015). During recent years, we have applied these techniques to study the microbial interconnections with bioavailability processes, involving pollutant phase exchange, microbial mobilization and cell attachment to interfaces. We can consider two groups of techniques; 1) Broadly applied methods to estimate the bioavailable contaminants using Tenax or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 14C-labelled chemicals. Examples and applications of these approaches will be summarized. They include desorption extraction (Environ. Sci. Technol. 45:3019-3026, 2011; Environ. Sci. Technol. 48:10869-10877, 2014), passive sampling and dosing methods (Environ. Toxicol. Chem. 27:1526-1532, 2008; Environ. Pollut. 184:435-442, 2014; Environ. Pollut. 205:378-384, 2015), constant NAPL/water interfacial area method (Environ. Sci. Technol. 45:1074-1081, 2011; Environ. Sci. Technol. 51:11935–11942, 2017), and radiorespirometry and dual 14Cresidue analysis (Environ. Pollut. 159:3692-3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability and biodegradation sciences. Still today, it is difficult to predict bioavailability of HOCs, for example, solely on the basis of basic parameters such as organic matter, black carbon or clay contents of a given soil or sediment, and the physicochemical constants of the chemicals (such as solubility in water, octanol-water or organic-carbon based distribution coefficients). This limitation even remains with improved assessments through determinations of chemical activity and biodegradability. This uncertainty not only applies to biodegradability in natural environments, but also to engineered remediation systems.

249 Strategy for ready biodegradability evaluation of poorly water-soluble organic compounds in aqueous media
P. Meynet, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering.

A series of standardised biodegradation screening tests (BSTs; e.g. OECD 301, 306) have been developed to measure the relative biodegradability of chemicals. Recently, regulatory emphasis has shifted from measuring biodegradation towards prioritisation of chemical persistence. In their current guise, BSTs are ineffective as screens for persistence. They are prone to high levels of variation and produce a large number of fails, many of which can be considered false negatives, whereby a chemical fails a test not because of its recalcitrance, but rather because the test itself has failed. An ECETOC funded workshop to discuss improvements to marine biodegradation testing was delivered in 2015. During this workshop, methodological improvements to BSTs were discussed, in addition to clarifying guidance on testing and interpretation of results obtained from marine BSTs.

Methodologically: (i) increasing bacterial cell concentrations to better represent the bacterial diversity inherent in the sampled environments; and (ii) increasing test durations to investigate extended lag phases observed in marine assessments, were recommended to be validated in a multi-institutional ring test. This presentation will report the findings from an international ring test of an improved marine BST, whereby an improved marine BST comprising inocula concentrated by tangential flow filtration, a modified marine BST comprising seawater and a standard OECD 306 closed bottle test were compared across 13 laboratories in the UK, Norway, Germany, Italy, Canada, USA and Japan. Five test chemicals including a positive reference compound (sodium octyl sulphate), a negative reference compound (pentachlorophenol) and three compounds with variable reported degradation (4-nitrophenol, triethanolamine and hydrolysed polycyclic amide), were used to provide a range of biodegradation potentials by which to validate the new method. Biodegradation data for the five chemicals, in the three test systems used, across the 13 participating laboratories will be presented. The need for clearer guidance on biodegradation testing and interpretation will be discussed, with particular reference to test variability and extended lag phases frequently encountered in marine biodegradation assessments. The role which microbial communities play in chemical biodegradation and the extent to which microbial community analysis can explain inter- and intra-laboratory variation in biodegradation test outcome will also be discussed.

250 Impact of temperature on micropollutants removal in an activated sludge system
P. Meynet, Newcastle University / CEGS; R.J. Davenport, Newcastle University / School of Engineering; K. Fenner, ETH Zürich/Eawag

The investigation of the environmental fate of pollutants is essential for evaluating their ecological impact and human exposure, and is a priority for the European water framework. In particular, the high variability of micropollutants removal efficiency in biotreatment systems is a major hindrance understanding of how plant performances are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arhenius-based models to estimate biotransformation rates at different temperatures, despite they neglect potential compositional and functional variation of the microbial community. This work aims to evaluate the validity of such models, by exploring the effect of short-term temperature variation on micropollutant biotransformation in an aerobic sludge community. Laboratory batch reactors were seeded with activated sludge from a Swiss full-scale treatment plant and the biotransformation of 93 target micropollutants (65g/L) was monitored over time at five different temperatures (4-40°C range). The experimental kinetic parameters were compared to the model predictions. The microbial population was also characterised by high-throughput sequencing to reveal community composition and activity during the biotransformations. Positive correlation of biotransformation rate constants with temperature was found in the 4-20°C range. At higher temperatures, the biotransformation potential decreased or reached a plateau for the majority of the compounds, and just a limited group showed a steady increase in biotransformation rates. Overall, the microbial community also showed significant shift in both composition and activity at higher temperatures, in agreement with the observed decrease in biotransformation potential. Contrarily, for compounds showing an Arhenius behaviour, the slope of the Arrhenius plot may be linked to basic living cell function or sensitivity to temperature fluctuations. Our study highlights limitations in the applicability of Arhenius-based models for the estimation of chemicals fate in biological systems, and the need to re-examine model parameters to assure more accurate predictions for potential chemical exposure in events of temperature fluctuations.

251 Findings from an international ring test for an improved marine biodegradation screening test
P. Meynet, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering.

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252 Relevance of photolysis for the fate of pendimethalin in deeper water layers - results of a scale-up approach according to OECD TG 309
D. Hennecke, Fraunhofer IOF - Institute for Molecular Biology and Applied Ecology / Ecological Chemistry; M. Kruse, Fraunhofer IOF - Institute for Molecular Biology and Applied Ecology; J. Hassink, BASF SE / Environmental Safety; OECD TG 309 “Aerobic Mineralisation in Surface Water” is currently used under different regulatory frameworks for the persistence assessment of chemicals in surface water. The test is performed in batch to measure biodegradation at defined conditions. Other processes which might be relevant for the fate of a chemical in surface water like direct and indirect photolysis are not addressed. Since photolysis is limited in the OECD 309 study, the consequences are critical for substances which are hydrolytically stable but sensitive to light. Within pesticide regulation direct photolysis studies are mandatory, indirect photolysis studies optional. In natural waters, which have to be used for OECD 309, both processes are relevant for photolytically unstable compounds. Hence, beside direct photolysis in the upper layer of a water column, it is interesting to know until which water depth indirect photolysis might contribute to degradation since the light intensity decreases with increasing water depth. A simulation approach has been performed considering the major conditions required in OECD 309 but at a much larger scale. Stainless steel containers of 900 liter volume are filled with surface water taken from a natural lake and maintained at 20°C. The geometry of the water level is 140 cm and a surface area of 0.70 m². In contrast to OECD 309 the system is exposed to simulated sunlight and the water is not mixed by stirring or shaking. Sampling is performed in 5 different water depths using permanently installed steel tubes of different length in order to avoid mechanical mixing of the water body by the sampling procedure. A second container with same test setup but equipped with a lid of stainless steel served as dark control. The test is conducted as both pelagic and suspended-sediment setup. Test substance was 14C-pendimethalin, which is known to degrade rapidly in aqueous systems under the influence of light. The purpose of the test was to determine if photolysis is a relevant process in natural water bodies under OECD 309 test conditions and up to which water depth this can be applied.
Integrating life cycle approaches towards a sustainable circular economy (I)

254 How can we measure a sustainable circular economy? Unveiling current indicators for the life cycle of products

H. Helander, A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

Currently, EU policy on circular economy (CE) aims to decrease environmental damage as well as secure the future supply of resources to support economic growth. Even though the implementation of new strategies might cause burden shifting, it is mostly assumed that an increased circularity of resources results in environmental benefits. At the same time, indicators suggested to assess CE progress often fail to provide an assessment of both CE goals and strategies from a sustainability perspective. A life cycle perspective provides a point of departure to address CE strategies, as the stages involved in the circulation of materials are clearly illustrated. Nevertheless, which indicators to assess is still to be defined to support the implementation of CE at any stage of the supply chain. This contribution aims to identify the type of indicators suggested to measure the progress towards a CE at a product level and to evaluate these in relation to the overarching goals and the implementation strategies of CE. To this end, we first define the main CE goals and implementation strategies identified in recent literature and translate these into measurable flows by creating a system model that accounts for each step in the product life cycle. Finally, we review the literature on CE indicators and classify them into CE goals and strategies, life cycle stages and flows addressed, and measurement units (i.e. economic, mass, energy or environmental impact). This contribution provides a consistent framework to compare and assess CE performance indicators at a product level. It also aims to develop a decision-making tool by assuming that the indicators through a structural assessment of currently suggested CE performance indicators, we can define gaps and needs in the monitoring process of CE to ensure that progress contributes to the overarching goals of CE and in turn capture trade-offs between implementation strategies.

255 Making sense of circularity indicators with Multi Criteria Decision Analysis

M. Nierø, Aalborg University / Department of Chemical and Biochemical Engineering & Department of Management Engineering; P.P. Kalbar, Indian Institute of Technology Bombay / Centre for Urban Science and Engineering (CUSE)

The focus of this study is on packaging, i.e. a sector with high priority for circular economy (CE) implementation, by exploring a situation where a company intends to compare the circularity performances of different products in order to identify which is the best option from a CE perspective. We considered six different packaging alternatives for beer in different contexts and calculated the following indicators to assess product-level circularity: i) the Material Reutilization Score (MRS); ii) a new Cradle to Cradle® certification program; iii) the Material Circularity Indicator (MCI) developed by the Ellen Mac Arthur Foundation and Granta and iii) the most relevant impact categories according to the Product Environmental Footprint Category Rules for beer product category, i.e. climate change (CC), acidification (Ac), and marine eutrophication (ME). The Multi Criteria Decision Analysis (MCDA) methodology provides an integration approach to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency. We argue that ranking the alternatives based on such approach will ease the identification of the best packaging alternative from a CE perspective. The MCDA is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDA method TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is used for ranking the six alternatives. The results of the stand-alone application of the two types of indicator sets, i.e. those focusing only on circularity (MRS and MCI) and on life cycle assessment (CC, Ac, ME) is different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCI and MRS are considered. The implementation of the MCDA with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.

256 Consistent allocation using archetype of LCA Goal and Scope definitions

D. Schrijvers, ISM; G. Sonnemann, University of Bordeaux / ISM CyVi

Identifying a suitable allocation procedure is always a challenge in the modelling of the life cycle impact of products. This is especially the case for metals. However, by recommending both partitioning and substitution for establishing the data for an attributional LCA, several inconsistencies are introduced. It becomes unclear to what research question LCA results respond if different modelling approaches are combined in a single LCA study. We developed archetypes of LCA Goal and Scope definitions – in the form of research questions – that aid in identifying a suitable and consistent allocation procedure. In order to identify suitable LCAs depending on the requirements of the LCA and scope need to be clearly defined: the topic of the LCA, the perspective, the reason to conduct the study, and potential additional functions of the product system that are taken into consideration. We present a framework that shows how the allocation procedure is dependent on the different LCA approaches that are defined in the goal and scope of the LCA. Based on this framework, building blocks are derived that are used to formulate research questions. These research questions represent archetypes of goal and scope definitions. The presented framework shows that there is a relevant difference between system expansion and substitution, and that we must differentiate between process-oriented and product-oriented LCAs, which is not common practice. Furthermore, we show that all types of LCA approaches can be used to support decision-making, which is often only ascribed to consequential LCAs. It is concluded that it is not the topic but the research question of the LCA study that determines the most suitable allocation procedure. One LCA topic (e.g. 1 kg of recycled aluminium) can already be used for at least 13 different research questions. “What is the impact of 1 kg of recycled aluminium?” is not detailed enough to identify an LCA modelling approach. This paper shows the level of detail that is required to enable this. The importance of a research question is not always obvious. The production phase of the laptop is modified to reflect a closed loop for recovered materials. The pre-processing of the laptop is modelled assuming a manual depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production sites, and a recycling facility. The MCDA optimization tool is used to provide an integration approach to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency.
where they can benefit from different residual flows that were previously being wasted. In ICTA-ICP building (4 floors), in the UAB campus (Bellaterra, Barcelona), a rainwater harvesting system stores rainwater on an underground tank, from which water is pumped to the rooftop to irrigate the crops with a hypodonic automatized system. In the third floor, high CO₂ concentrations (up to 820ppm) and more stabilized temperatures (between 15 and 22°C) are reached. The transport of the water to the rooftop could benefit crop production by performing a CO₂ enrichment and providing more suitable temperatures to the plants. In this aspect, an open chamber made of steel and LDPE will be used to compare its environmental performance and production with a control crop, using life cycle tools. In this direction, previous LCA studies have stated that the fertilizers are one of the items that exerts the greatest impacts in i-RTG systems. Hence, different nutrient ratios can be optimized. In this sense, different literature expresses that half of the currently economically phosphate resources will have been used up in 50 to 100 years. To optimize P cycle, struvite has been defined as a potential source of this nutrient. With a circular economy perspective, wastewater treatment plant precipitated struvite will be used as the P source for crops in the i-RTG in two different ways: mixing struvite in the nutrient solution and by adding struvite in perlite sacks (hypodonic substrate). The goal of this contribution is thus to evaluate the CO₂ and P cycles in an i-RTG through experimental and environmental studies by considering circular economy strategies. With these enhancements, urban agriculture will cut its environmental impacts, making it a more sustainable source of food for cities.

259 Chemical recycling of plastic packaging waste - A life cycle perspective on PET recycling

R. Meyz, RWTH Aachen University / Chair of Technical Thermodynamics; S. Westhues, RWTH Aachen University; J. Klauckemayer, RWTH Aachen University / Institute for Technical and Macromolecular Chemistry; A. Bardow, RWTH Aachen University

Plastic packaging waste is one of the priority areas inside the European action plan for the transition to a circular economy. To establish a circular economy, a potential large-scale avenue is chemical recycling of plastic packaging waste. However, preliminary assessments of chemical recycling technologies rate them inferior compared to mechanical recycling not only from an economic but also from an environmental point of view. Based on these results, a new method based on life cycle assessment to evaluate the environmental performance of chemical recycling to produce chemicals. The method calculates the maximal environmental impact reduction for chemical recycling technologies for future industry setups. To calculate the maximal environmental reduction, a general model of the life cycle of plastic packaging waste is developed from cradle-to-grave. The results are benchmarked against both mechanical recycling and energy recovery for the environmental impact categories climate change and fossil resource depletion. The basis of the calculations are four key system parameters: (i) the efficiency of the waste treatment technology and the environmental impacts of (ii) production of secondary materials, (iii) the waste treatment technology and (iv) the target chemical produced by chemical recycling. The presented method is used to evaluate chemical recycling technologies for polyethylene terephthalate (PET). In this case study, we show the need to produce high value-added chemicals from chemical recycling technologies to possibly achieve an environmental benefit compared to mechanical recycling. To improve on mechanical recycling, chemical recycling needs to yield a chemical that is currently produced with an impact on CO₂ and P cycles in an i-RTG system.

Informed substitution of hazardous chemicals for circular economy: science and practice

260 Substitution of PFOS under the Stockholm Convention


In 2009 PFOS, its salts and PFOFS were added to the UNEP Stockholm Convention aiming at protecting human health and the environment from POPs. However, the addition contained twenty exempted uses, for which PFOS could still be produced and used. These exemptions were accepted, accompanied by a deadline for these uses at regular intervals in order to facilitate a total phase out. Besides the evaluation, the Convention provides Guidance of alternatives to PFOS, which is regularly updated and meant to facilitate the Parties to the Convention in phasing out PFOS. The evaluation was carried out in 2014 under the POPs Review Committee. In 2016 the previous Guidance on alternatives was updated, followed by endorsement in 2017. The update focused on all known applications of PFOS, including the twenty exemptions. However, priority was given to the open applications in two pesticide uses, namely insect baits for control of leaf-cutting ants from Attta spp. and Acromyrmex spp. and insecticides for control of red imported fire ants and termites. Data on these uses was included in the last update of the Guidance. The document will focus on the further need of PFOS and the specific uses in various Parties under the convention and possible alternatives among which chemical and non-chemical ones. The recommendations of the POPs Review Committee led to the decision to request the Parties using PFOS for ant baits to deliver data on production and use and monitoring data on emissions at the points of use. In conclusion, that in phasing out a substance, it is necessary to understand the functional characteristics of the substance in that specific application and to follow a case by case approach. This enables to find alternatives and to define the proper measures. A multidisciplinary approach is indispensable in this phase-out process.

261 Experiences of "Substitution in Practice"

C. Jonsson, Swerea IVF AB / Energy and Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); I.v. Veen, Institute for Environmental Studies (IVU) / University Amsterdam; M. Peters, IVF AB / Energy and Environment; H. holmquist, Chalmers University of Technology; P. Leonards, U.V: G.M. Peters, Chalmers University of Technology / Department of Chemistry and Chemical Engineering; S. Posner, Swerea IVF, P.O. Box 104, SE-431 22 Malmö; A. Hanning, Swerea IVF AB

Within the research project SUPPES (Substitution of per Fluorinated compounds to Eliminate diffuse Sources) research on the substitution of hazardous chemicals in consumer products is focused on identifying feasible solutions with better sustainability performance. Such substitution model, suggesting evaluation for both technical as well as environmental and health performance, requires an interdisciplinary approach to create and/or identify feasible alternative solutions. Furthermore, a comparative life cycle assessment of chemical recycling and energy recovery in all studied cases. In this scientific paper, the authors present a tool for screening solutions in substitution projects. The tool can be used for different scale and scope of substitution projects. The tool is designed to improve the screening of alternatives for substitution projects, and to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects. The tool is designed to provide a basis for decision making in substitution projects.

Informed chemical substitution is about eliminating chemicals that give rise to unacceptable (eco)toxicological risks, while avoiding problem shifting within a product’s or chemical’s life cycle, or between types of impacts. For this reason, the life cycle perspective becomes crucial. Chemical alternative assessment (CAA) performance has been significantly improved in recent years, and life cycle assessment (LCA) and life cycle thinking are part of the more comprehensive CAA methods available. However, more detailed guidance is lacking and few practical examples have been published. A substitution case of current relevance is the phase-out of hazardous per- and polyfluoralkyl substances (PFAS) from durable water repellent (DWR) textile applications. Alternatives are sought which offer sustained technical performance and an improved environmental and human health profile compared to the hazardous PFAS. To support an informed substitution of hazardous PFAS, and complement our previous hazard assessment, we have conducted an LCA to compare environmental and human health impacts across DWR alternatives on a
functional basis. Based on this case we were also able to further elaborate on the inclusion of the life cycle perspective in a CCA framework by identifying both possibilities and challenges. We conclude that the inclusion of a life cycle perspective in CCA is crucial for an informed and sustainable substitution, as lack of life cycle thinking can lead to problem shifting. We show that LCA, with its focus on function, is a tool that can identify such problem shifting as well as the key chemical properties to consider. With the availability of toxicological effects in such a study, some can however turn out to be difficult, especially for substances such as the PFASs if they are outside the domain of the LCIA model. In the case under study here we conclude that the DWR should be selected with three main considerations: (i) the intrinsic hazard properties of the chemistry, selecting the DWR associated with the lowest hazard but, (ii) providing the functionality as needed and, (iii) giving the garment the longest life length.

263 How much function do we need in textiles? Strategies for replacing PFASs based on end-user requirements

S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); P. Hill, University of Leeds / School of Design; O. Levenshan, University of Borås; P. Gillgard, Swerea IVF AB; R. Blackburn, P. Goswami, M. Taylor, University of Leeds; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES)

Current approaches to substitute harmful chemicals could benefit from a broader perspective when it comes to the functionality they provide in consumer products. Following the concept of “functional substitute”, this study presents an evaluation of material properties of new durable water repellents (DWR) for textiles focusing on end-user requirements. Since the phase out of side-chain fluorinated polymers (SFPS) based on long perfluoroalkyl moieties that were associated with the release of persistent, biaccumulative and toxic perfluoroalkyl acids (PFAAs), a variety of new DWRs have been developed including biodegradable materials that are based on alternative renewable resources and their unique properties to provide substantial and oleophobic fibre modifications SFPS based on long perfluoroalkyl chains were historically used on all kinds of different textile applications. It is so far unclear if alternative DWRs can follow this “one solution will solve all” approach. By segmenting the textile sectors in terms of liquid repellency, this study sets out to outline the different requirements in case studies for functional outdoor clothing and occupational medical apparel. For functional outdoor clothing, a “bottom-up” strategy was chosen by using a survey to assess the consumers’ needs and expectations. For occupational medical apparel, exposure scenarios to liquids were defined based on protection needs described by the Center for Disease Control and Prevention (CDC). Based on these demands, relevant liquids were chosen to evaluate repellent properties of the provided DWRs using established test methods and by developing a new method to determine the roll-off angle for textiles. It has been found that some non-fluorinated DWRs based on green chemistry concepts showed excellent water repellence and also a resistance towards the penetration of liquids with intermediate polarity (e.g. orange juice and synthetic blood). When it comes to liquids with very low surface tension like gastric fluid evoking a flat wetting surface repellency, but not the only materials that protected against liquid penetration. This study of chemical substitution based on chemical and textile functionality as well as end-user requirements pointed out the opportunities and limitations for functional substitution.

264 Analysis of the technical and economic feasibility of alternatives to lead gunshot

A. Mazzolini, D. Mottet, P. Simpson, C. Logtmeijer, C. Rheinberger, M. Blaine, ECHA / Risk Management Implementation Unit

An analysis of the technical and economic feasibility of alternatives to lead gunshot has been prepared by ECHA as part of a REACH Annex XV Restriction Report on lead and lead compounds used in shot in wetlands. Lead has historically been used in cartridges because of its softness, low melting point, high density, relatively low price and high abundance. Because of these properties, lead is often considered to be the ideal material for use in ammunition. Steel gunshot (soft iron) is by far the most commonly used alternative; others include bismuth, lead and tungsten. The alternatives have a somewhat different ballistic behaviour, but they are still technically and economically suitable alternatives to lead gunshot. However, some adaptation is required by the shooter to use alternatives successfully, including the following: Adaptation of the shot size used as this would typically need to be increased to counter for the lower density of steel Awareness that shotguns are a shot weapon and will influence the ammunition performance, if fired at targets within a range of 35m Training should be done using shot of the same material as is intended for use in hunting/shooting This suggests that, in assessing hunting/shooting success, the individual skills of a shooter are more decisive than the type of ammunition used. The fact that several countries in the EU have implemented a full ban on the use of lead shot (for example Denmark and Netherlands) is evidence that alternative gunshot is suitable for both hunting activities and sports shooting. Steel shot is the most common alternative to lead gunshot due to its similar price per cartridge, making it the cheapest of the currently available alternatives. Some hunters may need to modify an existing shotgun to enable the use of steel gunshot. However, major gun manufacturers have confirmed that the vast majority of modern shotguns can fire alternative shot materials without any problem. In rare cases, a very old shotgun may need to be replaced or the hunter needs to use the more expensive bismuth or tungsten shot. The analysis of alternatives indicates that the use of alternatives to lead gunshot for hunting and shooting in wetlands is technically and economically feasible. While the availability of such alternative gunshot may currently vary across the EU Member States, it can be expected that a rise in demand triggered by an EU-wide regulatory action will be met on the supply side.

265 The road to successful substitution: case studies

N. Vallotton, N. Ball, Dow Europe GmbH / Toxicology Environmental Research and Consulting; H.M. Hollnagel, Dow Europe GmbH / Toxicology and Environmental Research and Consulting

Delivering innovative products and solutions to the market is a driver for research and development. Drivers of innovation include changes in the market demand or the availability of new technology. New substances or new products are continuously being evaluated for their performance and functionality and safety in a given adaptation. Adaptation to the market demand thus often leads to substitution in the use of one substance for another providing improved functionality. Beyond the evaluation of the product’s safety throughout its life-cycle, increased regulatory pressure such as possible changes in hazard classification plays a role in the selection of alternative candidate substances. In a limited number of cases, the evaluation of alternatives is required by regulatory frameworks, such as the authorisation process under the REACH regulation. However, substances of very high concern (SVHC) are identified solely based on their hazard profile (e.g. CMR or PBT properties), and do not consider findings from the overall safety assessment which includes an assessment of risk. Substitution driven by the hazard characterisation alone raises a number of questions in the search for alternative substances. Relevant candidates need to demonstrate equivalent or enhanced performance and functionality in the same range of applications and demonstrate a superior environmental and heath profile based on their hazard properties. However, there is a concern that substitutions based on hazard criteria may lead to regrettable substitutions, for example when it is unclear if a substitution presents a benefit in terms of overall risk to human health and the environment. Comparative risk assessment may prove to be complex as the substances typically do not have the same level of testing information to characterise the hazard. In addition, exposure may occur at greater levels when the uses require higher use rates or if processing and handling lead to higher exposures. Finally, identifying a candidate substance providing a broad range of functionalities allowing substitution in all given application requires a case study. In this study we aimed to illustrate the challenges faced by R&D scientists and the need to work closely with experts in disciplines as varied as chemistry, chemical engineering, EH&S specialist and application specialists during the long search for candidate substances having to meet value chain requirements in terms of performance and EH&S profile.

Big data analysis in ecotoxicology: how to get new information out of existing data?

266 EDAPHOBASE - soil biodiversity data warehouse and its applications in ecotoxicology

M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; U. Burkhardt, Senckenberg Museum of Natural History Görlitz; J. Hausen, RWTH Aachen University Institute for Environmental Research, Aachen; H. Höfer, Staatliches Museum für Naturkunde Karlsruhe; S. Jänsch, ECT Okotoxikologie GmbH; S. Lesch, Senckenberg Museum of Natural History (SMNG), Görlitz; J. Oellers, gaiac Research Institute for Ecosystem Analysis and Assessment, Aachen; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; F. Raub, State Museum of Natural History (SMNK), Karlsruhe; S. Rick, Senckenberg Museum of Natural History (SMNG), Görlitz; J. Rönnbke, ECT Okotoxikologie GmbH; B. Scholz-Starke, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; A. Toschki, Research Institute gaiac; D.J. Russell, Senckenberg Museum of Natural History, Görlitz

In this talk we present the soil-zoological information System EDAPHOBASE, a taxonomic-ecological database system, developed within a joined research project funded by the German Federal Ministry of Education and Research (BMBF). It combines existing taxonomical primary data on soil organisms from collections, specific literature and reports in a data warehouse. Up to now EDAPHOBASE contains more than 50000 observations, about 30000 sites, an 140000 taxa. Data can easily be imported, quality checked, published, queried and analyzed via a web application interface. Detailed analyses can be performed with the interactive web application EDAPHOSTAT which allows species-level analysis as well as definition of reference communities. Future development of EDAPHOBASE towards a pan-European ecotoxicological database system will focus on (1) the development of a harmonized tool for the evaluation of ecological soil quality, (2) the collection and usage of existing data from different parties all over the
Europe, (3) the provision of a reference base of the ecological quality of soils and (4) the coverage of relevant needs of as many as possible European policies. Finally, necessities for practical use in common agricultural policy, circular economy and for EU transboundary issues are discussed.

267 Diving into REACH database with Rstudio to produce input data for the USEtox model for thousands of chemicals

In the context of the EU commission product environmental footprint activities (PEF) [1,2], the potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model [3]. For each single chemical, this model requires dozens of physico-chemical parameters as well as data on ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer endpoints. For PEF those data are required for thousands of chemicals, using the most up-to-date information [4,5]. The EU commission Joint Research Centre has obtained from the European Chemicals Agency (ECHA) data on more than eight thousand chemicals. These data includes all the physico-chemical properties (166'926 test results), ecotoxicity (305'068 test results) and human toxicity data (41'381 test results) available in the IUCLID 5.5 database (as of May 2020). Data were processed based on unique key values for chemical properties and toxicity indicators for thousands of chemicals. The present paper focuses on the use of REACH data to calculate Chemical Effect Factors. All the REACH registration data on physico-chemical, aquatic ecotoxicity and human toxicity were exported from the IUCLID 5.5 database into individual Excel files. Each Excel file was imported into the R-studio program [6] where data treatments / manipulations / calculations were performed. R allowed us to build code in step wise manner until we obtained the desired selection without impacting the structure of the original file (Excel). The final code can be released to the scientific community to be reapplied on the original files obtained from the REACH database. The ecotoxicity data extracted from the IUCLID database contained about 7500 substances covering both mono and multi-constituents as well as UVCB (Unknown or Variable composition, Complex reaction products or Biological materials). The database covers acute and chronic toxicity tests for various organisms with about 305'068 End-point study reports (ESR).

268 The effect of modelling decisions on macroinvertebrate sensitivity modelling
S.v. Berg, Wageningen University & Research / Aquatic Ecology and Water Quality Management; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C. Rendal, Unilever / Safety and Environmental Assurance Centre SEAC; E. Butler, Unilever; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology and Aquatic Toxicology / Wageningen UR / Aquatic Ecology and Water Quality Management group b Alterra.

Main challenges in modern ecological risk assessment (ERA) lie in the simultaneous occurrence of species diversity and compound multiplicity. The recent development of trait-based sensitivity models has proven to be successful in tackling this problem. However, this methodology is one of the first of its kind, and hardly any data were available. R allowed us to build code in step wise manner until we obtained the desired selection without impacting the structure of the original file (Excel). The final code can be released to the scientific community to be reapplied on the original files obtained from the REACH database. The ecotoxicity data extracted from the IUCLID database contained about 7500 substances covering both mono and multi-constituents as well as UVCB (Unknown or Variable composition, Complex reaction products or Biological materials). The database covers acute and chronic toxicity tests for various organisms with about 305'068 End-point study reports (ESR).

269 New approach facing new challenges in Ecotoxicology: D counter
S. Abreu, University of Aveiro / Dep. Biology & CESAM; A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DETI / IEETA.

Routine tests in Ecotoxicology are simple, relatively inexpensive and rapid methods. They can be used to compare the sensitivity of various bioassays to chemical pollutants but data are globally missing for marine organisms. In addition, studies have mainly been focused on only one species under the same exposure, but toxicity exposure involving several species are scarce. D counter is an innovative device that can be used in ecotoxicology assays involving not only one, but also two or more different species, and proving separated data from each of the species coexisting under simultaneous exposure, whenever chronic differentiation can be achieved among the species. D counter has been mainly pointed to organisms with body sizes from 0.2mm to 3mm, but it also has been tested with larger organisms, and it can be applied either to freshwater, estuarine or marine species, being suitable in bioassays using for example, the brine shrimp Artemia salina nauplii (within width of 50 h of hatching) or nematodes (less than 24 h old) from Daphnia magna or D. longispina, or even Acartia tonsa nauplii. How it works? - First it is necessary to extract the characteristic signal from sets of organisms belonging to each of the species involved in the study; this is done with a software based pattern identification and recognition procedure using training sets of organisms of each species, which will provide the tools for pattern recognition in the subsequent tests. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for each single organism under test, either being from different species, presenting sub–tots – by species – and/or total counting when required. The application of these device in bioassays do not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

270 Ceriodaphnia is equisensitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements
K.A. Connors, S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization.

The OECD 202 Acute Daphnia Toxicity Test is an OECD 202 Acute Daphnia Toxicity Test requires the use of Daphnia magna or another “suitable Daphnia species, (e.g., Daphnia pulex)” [7]. The zooplankton Ceriodaphnia dubia is not considered a standard test species for chemical registration in Europe despite the availability of ISO and USEPA standard acute and chronic test methods and its wide use and acceptance in other countries. Standard acute assays conducted with C. dubia submitted to fulfill REACH dossiers can only be used as supporting or weight of evidence studies and not as key exposure. Then, simply present the battery of exposures (mixed species or single) to the device by just pouring the (tens of) flasks to the serialization component in the D counter device. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for each single organism under test, either being from different species, presenting sub–tots – by species – and/or total counting when required. The application of these device in bioassays do not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

Poster spotlight: TU001, TU002, TU003

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (II)
272 Assessment and management of stormwater on sediment recontamination due to metal contaminants

I. Dryvonekis, Texas Tech University / Department of Civil Environmental and Construction Engineering; B. Rao, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; M. Bejar, Texas Tech University; D. Athanasou, Texas Tech University / Civil, Environmental, and Construction Engineering; D.D. Reible, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; B. Chadwick, US Navy Spawar Systems Center; G. Rosen, M. Colvin, SPAWAR Systems Center Pacific; R. Pint, The University of Alabama; E. Strecker, B. Steets, M. Otto, Geosyntec Consultants

There is a lack of understanding on the association of diffuse sources, such as episodic storm events, in the metal recontamination of sediments. The study objective is to define the effect of metals associated with storm events, with regards to the sediment recontamination in the Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and metal analysis. Receiving and outfall waters were monitored for sediment deposition, contaminant water, and porewater, using auto-samplers which were triggered at each location during two different seasons. Sediments collected in outfalls, deposition traps and sediment deposits were also subjected to chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050A and 3050B, respectively, and were analyzed using ICP-MS and MER-X-T. The samples were analyzed for a variety of metals, i.e., Cu, Pb, Cd, Ni, and THg. A similar approach was used to represent the percentages of clay, fine silt, coarse silt, and sand, which represent particles that could be most directly related to recontamination potential. The results show that over the time the contaminant loadings decreased due to reduction in particulate contaminants while the concentrations in finer, and dissolved fractions remained relatively constant. Cu, Pb, and Ni were associated with the largest particles in stormwater, but only Cd is strongly associated with sediment recontamination. Cu, Pb, and Ni are associated with the dissolved phase, fine silt and clay in stormwater and present moderate impact on sediment recontamination. In addition to showing a greater dissolved fraction it appears that the depositing loads are more influenced by resuspension and redistribution of sediment than stormwater. The THg load is relatively small in stormwater recontamination does not add appreciably to sediment THg loads. The particle associations in stormwater along with spatial distribution in sediment traps can identify sources, contributing locations and effective remedial approaches. The implications of the study, can be the development of identification tools that give information about the potential mobility-transport of the metals during storm events, identification of contributing locations, effective remedial approaches, and thus, help to propose best practices for stormwater and sediment management.

273 The effect of percolation and form on lead bioavailability and toxicity to Enchytraeus crypticus


In the standard toxicity tests, metals are spiked freshly into test soils as easily soluble metal salts. This may lead to an inaccurate estimation of metal toxicity in soil, as it may not mimic the fate of metals in contaminated fields while the counterion could also have a toxic effect on soil organisms. The present study was set up to investigate the bioavailability and toxicity of lead nitrate (Pb(NO3)2) and lead oxide (PbO) to the potworm Enchytraeus crypticus freshly spiked and 18-months aged Lufa 2.2 soil, with and without leaching. Survival and reproduction after 21 days exposure were related to total, 0.01 M CaCl2 extractable and porewater Pb concentrations in the soil and internal Pb concentrations in the surviving animals. For all treatments, 0.01 M CaCl2 extractable and porewater Pb concentrations showed a slight decrease after percolation (Pb(NO3)2), while more toxic to the enchytraeids than PbO, both for survival and reproduction and in both freshly spiked and aged soils. LC50 for the effect on enchytraeid survival, based on total Pb concentrations in the soils, did not differ for PbO after percolation in freshly spiked soils and aged soils, but increased from 1380 and 500 mg Pb/kg dry soil to 1521 and 608 mg Pb/kg dry soil in freshly spiked soils and aged soils, respectively for (Pb(NO3)2). LC50 based on 0.01 M CaCl2 extractable Pb concentrations presented an increase from 2.07 to 1.72 and 2.78 to 2.42 mg Pb/kg dry soil after percolation in freshly spiked soils and aged soils for Pb(NO3)2, and a slight decreased from 2.79 and 2.45 to 2.16 and 2.18 mg Pb/kg dry soil after percolation in freshly contaminated soils and aged soils for PbO. LC50 values related to internal Pb concentrations were both Pb(NO3)2 and PbO, and ranged from 75.6 to 81.1 mg Pb/kg dry body wt in all treatments, indicating that survival of E. crypticus was better expained from internal Pb concentrations in the worms than from total or available Pb concentrations in the soil. In general, percolation did not affect total or Pb availability in the soil for Pb(NO3)2, suggesting that the counterion might have influenced Pb toxicity when Pb salts were used in the standard toxicity tests. Thus, leaching the contaminated soils before testing or using the oxide form of metals might be good ways to get rid of the influence of counterions and increase environmental realism of laboratory toxicity studies.

274 To leach or not to leach: Soil enzymatic responses to metal mixture species

F. Awual, University of Saskatchewan / Toxicology Centre; S. Siciliano, University of Saskatchewan / Department of Soil Science; B.A. Hale, University of Guelph / School of Environmental Sciences

Presentation Type: Presentation preferred Abstract Title: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awual, B. Hale, S. Siciliano, University of Saskatchewan, Toxicology Center. University of Guelph, School of Environmental Sciences. Abstract: In soil laboratory experiments, metal mixture studies are usually carried out with metals dosed as salts, followed by leaching with artificial rainwater to remove excess salts. In the leaching process, metals are lost unequally, which affects the ratio of the mixtures in the soil. An efficient way of carrying out metal mixture experiments is by using the fixed ratio ray design. This design reduces the amount of experimental effort and allows the estimation of both additivity and interactions. In using this design, metal concentrations should be fixed in specific ratios, but this is compromised when soils are leached. Hence, an alternative method of dosing that allowed fixed ratio testing had to be determined. Two proposed alternatives were metal oxides and spinel minerals which were both abundantly found in aged salt spiked soils and field metal contaminated soils. The toxicity of the oxides and minerals to soil enzymes were tested and compared to the salts. The experiment was conducted with three Canadian soils (pH: 3.5-7), three metal species, five fixed metal(loid) mixtures, and five metals (Pb, Cu, Co, Ni, Zn) at one dose. The activity of the soil enzymes ammonia monoxygenases, beta-glucosidases, acid-phosphatases and aryl sulphatases were determined colorimetrically. Results showed that leaching alone significantly inhibits the enzyme ammonia monoxygenases in all three soils. The response of acid phosphatases to the metal mixture rays followed known paradigms of bioaccessible concentrations defining toxicity. However, the response of ammonia monoxygenases followed a non-linear hormetic toxicity across the three soils. Here, ray toxicity was highest in the soil with a pH value of 5 and vice versa for pH 3 and 7. Generally, metal salts were the most toxic form, and the spinel minerals were the least toxic. Metal oxides were chosen as a replacement for carrying out metal mixture studies in soils because no leaching was required and it was more toxic than the minerals. Keywords: Fixed ratio ray, metal oxides, spinel minerals

275 Soil moisture influences the avoidance behaviour of Folsomia candida and Enchytraeus crypticus in metal(loid)-contaminated soils

M. Abdul-Alkareem, Department of Biological & Environmental Engineering; M. University of Aveiro / Biofl y & CESAM; C. Malheiro, Department of Biology, University of Aveiro / Biology; D. Nunes Cardoso, CESAM, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology

This study aimed to assess the effects of soil moisture content on the avoidance behaviour of the soil invertebrate species Folsomia candida (arthropod) and Enchytraeus crypticus (soft-bodied oligochaete) in metal(loid)-contaminated soils. Two metal(loid)-contaminated soils from Central Portugal were selected as test soils (mining soil with pH=5.9; agricultural soil with pH=4.8). Avoidance behaviour was evaluated in two-section vessels for 48 h at 20 °C. Lufa 2.2 soil was used as control soil. Avoidance tests were performed at different soil moisture contents (expressed as soil water holding capacity, WHC): 50% (standard soil moisture), 75% (to simulate floods) and 25% (to simulate droughts). Different soil moisture content combinations were tested (test soil WHC vs. control soil WHC): 1) 50% vs. 50%, 2) 75% vs. 75%, 3) 25% vs. 25%, 4) 50% vs. 75%, 5) 50% vs. 25%, 6) 75% vs. 50%, 7) 25% vs. 50%. Porewater metal(loid) concentrations were analysed by ICP-MS in soils incubated at 50%, 75% and 25% WHC for 48 h at 20 °C. Soil moisture at 75% WHC had higher porewater metal(loid) concentrations than those moistened at 50% and 25% WHC. This was more pronounced in the agricultural soil (e.g. 2.5-fold higher Mn, Ni and Pb concentrations at 75% soil WHC). F. candida did not avoid both metal(loid)-contaminated soils when tests were performed at the same moisture content in test and control soils while E. crypticus did, but only at 50% soil WHC moisture content (avoidance). While for F. candida avoidance was performed in test and control soils the behaviour of both invertebrate species was mainly controlled by soil moisture content. F. candida had a preference for soils moistened at 50% WHC, regardless the soils were contaminated or not. E. crypticus avoided both metal(loid)-contaminated soils in all the soil moisture combinations tested (~10-100% avoidance), except when the control soil was at drier conditions than the test soils. The present study showed that: 1) porewater metal(loid) availability was increased with increasing soil moisture content, especially in soils with higher acidity; 2) F. candida and E. crypticus differed in their capacity to avoid metal(loid)-contaminated soils; 3) F. candida preferred soils moistened at 50% WHC, regardless soils were contaminated or not; 4) E. crypticus could avoid metal(loid)-contaminated soils but its capacity was highly dependent on soil moisture conditions.

276 Manganese bioavailability in legacy contaminated soils by medieval
metallicurgical wastes

F. Gimbert, H. Gauthier-Manuel, R. Colquent, D. Radosa, F. Choulet, and P. Petitjean, University of Bourgogne Franche-Comté / UMR ChronoEnvironnement; A. Walter-Simonet, University of Bourgogne Franche-Comté, UMR UFC/CNRS 6249; H. Laurent, DRAC Bourgogne Franche-Comté; A. de Vaulx, Franche-Comté / Department of Chrono-Environment

In this review, we report on the development and use of novel biological tools to improve the quality of soils remediated by mining activities. The amendments were also able to inhibit the activity of dehydrogenase. The amendments were also able to inhibit the activity of dehydrogenase. The amendments were also able to inhibit the activity of dehydrogenase. The amendments were also able to inhibit the activity of dehydrogenase. The amendments were also able to inhibit the activity of dehydrogenase.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (II)

278 Profile of microplastics in water and sediments of Antuã river in Portugal

M.O. Rodrigues, Department of Biology & CESAM - University of Aveiro / Department of Biology; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; H. Nogueira, Universidade de Aveiro / Department of Chemistry; J.C. Marques, University of Coimbra / MARE, Dept. of Life Sciences, Coimbra University, N. Abrantes, University of Aveiro / CESAM/DAO; A.M. Caldas, MARE, Dept. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University

The accumulation of plastics in aquatic systems, especially, microplastics (particles with < 5 mm) is of particular apprehension since they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. These microplastics (MPs) differ by their physico-chemical properties (e.g., size, shape, colour, density and polymer type) as well as in their origin (primary or secondary). Notwithstanding, the occurrence of microplastics (MPs) in freshwater systems is less understood than in marine environment. Hence, the present study aims to fill this knowledge gap providing new insights into MPs contamination in Antuã river in to water and sediment samples collected in March and October of 2016 in several stretches of the river. The abundance of MPs reached 143 ± 18.3 mg m⁻³ or 306.4 ± 472.1 items m⁻³ in water samples and 35.8 ± 25.7 mg kg⁻¹ or 318.9 ± 246 items kg⁻¹ in sediments. It shows that this river is severely infested by MPs, especially in water compartment. Spatial and temporal distributions show different pattern according to seasonal conditions, proximity to urban areas and flow velocity. The water and sediment samples with the greatest abundances were Santa João de Madeira and Aguineira, respectively. In water compartment, the highest abundance of MPs was observed in October, while in sediments an opposite pattern was observed. Analysis of plastics by Fourier transform infrared spectroscopy (FTIR) underline polyethylene (PE) and polypropylene (PP) polymers as the most common types covering more than 50% of all polymer types identified. Furthermore, the low medium high oxidation ratio for these particles were 54:38:9% indicating that fewer particles are highly oxidized. Foams and fibers were the most abundant type in São João do Madeira, while fibers and fragments are the most abundant in Aguineira and Estarreja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (~1 mt) and 10%-50% of plastic go to landfills, it is urgent to monitor its freshwater systems. This study emphasizes also the importance of rivers as potential carryages of MPs within environment. Further studies should be performed to identify point sources in order to mitigate the MP contamination in aquatic systems.

279 Microplastics in German rivers - first monitoring results

M. Hess, LANUV NRW / Water management, water protection; C. Laforesch, University of Bayreuth; P. Diehl, State Environment Agency Rhineland-Palatinate; H. Imhof, University of Bayreuth / Animal Ecology I; M. Loeder, University of Bayreuth; J. Mayer, Hessian Agency for Nature Conservation, Environment and Geology; H. Rahm, North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection; W. Reifenhäuser, Bavarian Environment Agency, Wielenbach; I. Schrank, University of Bayreuth; J. Stark, State Institute for Environment, Measurements and Nature Conservation Baden-Württemberg; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology Plastics are an indispensable component of our daily lives due to their diverse applications. In consequence of improper handling or disposal, plastics can enter surface waters and persist over a long period due to their low degradation. About 4.8 to 12.7 million tonnes of plastic waste are released into the oceans each year. Rivers and wastewater discharges may contribute significantly to the contamination of the marine environment. Despite an obvious causal link between the (micro)plastic load of inland waters and marine ecosystems, European rivers have been investigated for the presence of microplastics (MPs) only recently. However, the analytical results of different studies are usually not comparable among each other due to different methods of sampling, processing and analysis of microplastics. In Germany, five federal states initialised monitoring programmes to get a first overview on the microplastic load of inland water systems: Rhineland-Palatinate, Bavaria, North Rhine-Westphalia, Hesse and Rhineland-Palatinate in cooperation with the University of Bayreuth. Monitoring was performed in terms of abiotic and biotic microplastics by Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). For this purpose, we carried out three interdisciplinary and complementary approaches: i) mineralogical characterisation of slags derived from a variety of sources and can interact with biotic and abiotic environment. These microplastics (MPs) differ by their physico-chemical properties (e.g., size, shape, colour, density and polymer type) as well as in their origin (primary or secondary). Notwithstanding, the occurrence of microplastics (MPs) in freshwater systems is less understood than in marine environment. Hence, the present study aims to fill this knowledge gap providing new insights into MPs contamination in Antuã river. In water and sediment samples collected in March and October of 2016 in several stretches of the river. The abundance of MPs reached 143 ± 18.3 mg m⁻³ or 306.4 ± 472.1 items m⁻³ in water samples and 35.8 ± 25.7 mg kg⁻¹ or 318.9 ± 246 items kg⁻¹ in sediments. It shows that this river is severely infested by MPs, especially in water compartment. Spatial and temporal distributions show different pattern according to seasonal conditions, proximity to urban areas and flow velocity. The water and sediment samples with the greatest abundances were Santa João de Madeira and Aguineira, respectively. In water compartment, the highest abundance of MPs was observed in October, while in sediments an opposite pattern was observed. Analysis of plastics by Fourier transform infrared spectroscopy (FTIR) underline polyethylene (PE) and polypropylene (PP) polymers as the most common types covering more than 50% of all polymer types identified. Furthermore, the low medium high oxidation ratio for these particles were 54:38:9% indicating that fewer particles are highly oxidized. Foams and fibers were the most abundant type in São João do Madeira, while fibers and fragments are the most abundant in Aguineira and Estarreja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (~1 mt) and 10%-50% of plastic go to landfills, it is urgent to monitor its freshwater systems. This study emphasizes also the importance of rivers as potential carryages of MPs within environment. Further studies should be performed to identify point sources in order to mitigate the MP contamination in aquatic systems.
Exploring the relation between plastic concentration and river discharge in an urban river

S. Wagner, Helmholtz Centre for Environmental Research GmbH - UFZ / Department of Environmental Geoscience; P.E. Kloekener, Helmholtz Centre for Environmental Research GmbH - UFZ / Analytical Chemistry; C. Schmidt, Helmholtz Centre for Environmental Research GmbH - UFZ / Hydrogeology; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry

Rivers play a major role in transport of plastic debris from inland sources into the marine environment. Presently the relevance of various individual sources and emission pathways of plastic in rivers such as wastewater treatment plants, combined sewer overflows, surface runoff and littering can hardly be quantified. Therefore plastic emission from sub-catchments is determined by integral approaches. This study examines plastic particle concentration upstream (P1) and downstream (P2) of an urban subcatchment and establishes relationships between river discharge and plastic concentration (c-Q relationship). Suspended material > 500 µm was sampled at two sampling sites in the Parthe River, (Leipzig, Germany) and downstream (P1) and has been (P2) of an industrial catchment during 17 campaigns each for 24 h. Plastic material was extracted and quantified in the suspended matter using particle size fractionation, density separation and particle cleanup follow-up by Raman spectroscopy. Plastic particle mass and number concentration were determined and it was observed that plastic concentration and load increased in the urban subcatchment. To explain the observed concentration and load increase of plastic input in both subcatchments was related to the catchment attributes population, catchment size, urban area, and river length revealing that population determines plastic emissions. The log-log c-Q plots of total plastic mass and particle number concentrations show an enrichment pattern at P2, hence increasing concentration with increasing discharge (positive slope b of the regression). At P1 no significant c-Q relationship was observed. This indicates that in the rural sub-catchment increasing discharge does not drive an increased mobilization of plastic material. The c-Q relationship was applied to estimate the yearly plastic emission based on river discharge data.

281 Microplastic pollution in upstream river catchments

T. Stanton, M. Johnson, P. Nathanial, The University of Nottingham / School of Geography; R.L. Gomes, The University of Nottingham / Faculty of Engineering; W. Macnaughton, The University of Nottingham / School of Biosciences

Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally and have been associated with wastewater treatment plants and centres of population and industry. However, the extent to which they pervade upstream catchments is comparatively underrepresented in the study of freshwater microplastic pollution. Results presented here form part of a year-long project that aims to quantify the spatial and temporal variation of microplastic pollution in rural headwaters and urban rivers that do not receive wastewater treatment effluent across England’s Midlands, as well as in atmospheric fallout. FTIR analysis of three months’ samples identified microplastic particles in 30 litre water samples taken from the headwaters of the River Trent and its tributaries. It has also been used to identify non-fibrous microplastic fragments in rural and (sub)urban atmospheric fallout. Moreover, spherical particles that resemble those used in cosmetic / personal care products have been identified in rivers that do not receive wastewater treatment effluent.

282 Microplastics in stormwater ponds

F. Liug, Aalborg University / Civil Engineering Department; K.B. Olesen, K.B. Olesen, Aalborg University / Department of Civil Engineering; M. Simon, Aalborg University; N. van Alst, J. Vollertsen, Aalborg University / Civil Engineering Department

Stormwater runoff contains pollutants from land surfaces. As the majority of production and consumption of synthetic polymers is happened on land, microplastic (MP) is one group of problematic pollutants in urban stormwater runoff. However, MPs in stormwater has barely been investigated. A large part of the urban stormwater runoff is treated in retention ponds prior to discharge. This study looked into the occurrence, composition and concentration of MP in stormwater ponds, aiming to evaluate the retention efficiency of MP by these systems. The results will contribute to the understanding of MP emission from urban areas, and potential impacts on adjacent environmental compartments. Seven stormwater ponds in Denmark were selected as study sites. Surface water was collected using a pumping system equipped with a 10 µm mesh stainless steel filter. Sediment samples were collected using an Ekman bottom grab sampler. The filters from the water samplings were pre-oxidized with H2O2, followed by enzyme treatment. secondary oxidation was applied afterwards. Inorganic particles were separated by density separation using ZnCl2. Sediment samples were freeze dried and incubated in SDS solution. Enzymes were then added, followed by density separation using ZnCl2. After extraction, particles (from 10 to 2000 µm) were concentrated in 50% ethanol solution. A sub-sample was deposited onto a ZnSe window and dried. The window was scanned by micro-Fourier Transformed Infrared Spectroscopy imaging an Agilent Cary 620/670 system with a 128x128 pixel FPA. The software MPHunter was used to interpret spectrums. MPs were detected in water phase of all ponds. The most abundant polymers were PP, PE and PS. The highest concentration in terms of particle number was 10.8 particle/L, while the other 6 ponds ranged from 0.07 to 2.45 particle/L. For MP mass the highest concentration was 1.2 µg/L while the other 6 ponds ranged from 0.06 to 0.4 µg/L. High density polymers were also detected in some of the ponds, this is likely due to the resuspension of sediment by wind and traps of MPs by organisms. Sediment samples are still under processing and will be included in the final presentation. Nevertheless, the water samples have shown that stormwater pond do not retain all MPs, particularly for low-density polymers. With the high mobility, discharges from stormwater ponds will potentially affect adjacent environmental compartments.

283 Towards a more realistic assessment of microplastics as pollutant transporter: a combined experimental and modelling study

S. Seidensticker, C. Zarlf, O. Cinpka, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geosciences

Microplastics are ubiquitous in the environment and are transported with various compounds. In such systems, hydrophobic organic contaminants are often associated with particles such as microplastics (MP) which are ubiquitously detected and have raised concern. The release of pollutants from such particles is a combination of two different diffusive fluxes. External mass transfer governed by diffusion through an aqueous boundary layer on the one hand and internal mass transfer limited by the intraparticle diffusion coefficient on the other hand. Among these, the latter mechanism controls the kinetics depends on various factors, such as partition coefficients, particle properties, boundary conditions, and time. The aim of this study was to identify if and how observations of pollutant release from MP under laboratory conditions can be transferred to field conditions. We formulated a coupled mass-transfer model to consider both, external and internal mass transfer, and analysed an analytical solution via Laplace transformation. For model evaluation, we performed batch experiments with different wastewater contaminants with varying hydrophobicity and at different amounts of dissolved organic matter, which changes the overall partitioning between the MP and the water phase. We measured equilibrium partition coefficients and release kinetics over 240 hours. Based on experimental data and the analytical solution of the model, characteristic times of mass transfer were calculated. These are proxies for the equilibrium time and can be used to assess the relative importance of the two mass-transfer processes. Results show, that mass transfer for hydrophilic compounds usually is limited by intraparticle diffusion whereas for hydrophobic compounds it is externally limited. For intermediate compounds, a shift from internal to external dominance was observed. Calculated characteristic times show that under lab conditions the overall equilibrium time decreased with increasing partition coefficient while under field conditions the opposite is the case. Thus, a simple first-order approximation of mass transfer would not be enough to transfer experimental results to field conditions adequately. Rather, it is necessary to consider true intraparticle diffusion. Application of our model to different particle sizes, shapes, materials and for varying particle concentrations underlines the fundamental differences between lab and field and allows the transferability between these different boundary conditions.

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284 Analysis of the contribution of a coal-fired power plant to PM10 concentrations in four sites in Southern Italy

D. Centini, Istituto di Scienze dell’Ambiente e del CLima-CNR / Division of Lecce; D. Cesari, E. Merico, Instituto of Atmospheric Sciences and Climate, CNR; F.M. Grasso, A. Dinolf, Instituto of Atmospheric Sciences and Climate, CNR / Division of Lecce; A. Genga, M. Siciliano, University of Salento; M. Berico, A. Malaguti, ENEA / SSPT-MET-INAT Via Martiri di Monte Sole 4, 40129 Bologna, Italy

This study is aimed to perform a source apportionment of PM10 collected simultaneously in four sites located in the Puglia region (South-Eastern Italy). The
Air pollution toxicity: is it the right time to leave the bench for the field? A case study integrated approach

M. Guatieri, ENEA / MET-INAT; F. Costabile, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; M. Grollino, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; P. Avino, INAIL / Department of Technological Innovations; IV Via Napoli 144, 00187 Rome, Italy; E. Cordelli, G. Raschelli, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; A. Malagutti, E. Petralia, ENEA / SSPT-MET-INAT Via Martiri di Monte Sole 4, 40129 Bologna, Italy; T. La Torretta, M. Stracquadanio, ENEA; M. Manigrasso, INAIL / Department of Technological Innovations, IV Via Napoli 144, 00187 Rome, Italy; A. Wiedensohler, Leibniz Institute for Tropospheric Research / Permoserstrasse 15, 04318 Leipzig, Germany; G. Cremona, ENEA; K. Weinhold, Leibniz Institute for Tropospheric Research / Permoserstrasse 15, 04318 Leipzig, Germany; D. Li, Di Liberto, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; C. Consales, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; M. Berico, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; M. Aufderheide, CULTEX LABORATORIES GmbH / Feodor-Lynen-Straße 21, 30625 Hannover, Germany; G. Gobbi, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; G. Zanini, ENEA / SSPT-MET Via Martiri di Monte Sole 4, 40129 Bologna, Italy

Air pollution (AP) is recognize as the most important environmental issue affecting human health. In Europe AP is responsible for 500,000 premature deaths mainly due to non-communicable diseases and disabilities. The epidemiological associations have already evidenced significant relationship between increases in risk factors for selected human diseases and air pollutants concentration. Finally IARC has classified outdoor air pollution as carcinogenic to humans (Group 1). During the last decades several toxicological studies have investigated the human health effects of air pollutants, including the relationship between air pollution and the development of cancer. In this work we present some results of a recent research project on air pollution performed in the North part of France.

In this context it is important to know the real levels of the main pollutants indoor and outdoor and to understand the mechanisms at the basis of their toxic effects. With this purpose we decided to carry out a retrospective study in the North part of France about indoor and outdoor air contamination by EDCs. According to the methodology previously validated, several indoor and outdoor exposure systems have been set up in different sites, the EDCs concentrations in air in the North part of France are in the same order than those in Paris region. In conclusion, the air contamination by EDCs in the North part of France is a serious concern and the research is needed to identify the sources of pollution and to develop strategies to reduce the exposure to these contaminants.
implementing policies of public health protection.

290 The role of the p38-activated protein kinase signaling pathway-mediated autophagy in cadmium-exposed monogonont rotifer Brachionus koreanus

H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

Autophagy is a self-eating system that regulates the degradation of cellular components and organelles. It is involved in various biological processes, including aging and development. However, despite its crucial role in organisms, the regulatory mechanism of autophagy remains largely unclear, particularly in invertebrates. In this study, conserved autophagy in the rotifer Brachionus koreanus in response to cadmium (Cd) exposure was verified by measuring acidic vesicle organelles using acridine orange (AO) and neutral red (NR) staining, and by detecting LC3 III on Western blot and immunofluorescence. We also demonstrated activation of the mitogen-activated protein kinase (MAPK) in response to Cd-induced oxidative stress, leading to the induction of autophagy in B. koreanus. This was further verified by analysis of MAPK protein levels and immunofluorescence of LC3 II after treatment with reactive oxygen species scavengers and inhibitors specific to MAPKs. We propose a p38 MAPK-mediated regulatory mechanism of autophagy in B. koreanus in response to Cd-induced oxidative stress. This study will contribute to a better understanding of autophagic processes in invertebrates and its modulation by environmental stressors.

291 Effects of triclosan on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigriopus japonicus

J. Park, J. Lee, Sungkyunkwan University

Triclosan (TCS) is an antimicrobial agent that has been widely dispersed and detected in the marine environment. However, the effects of TCS in marine invertebrates are poorly understood. In this study, the effects of TCS on life cycle parameter (e.g., mortality and fecundity) along with cellular reactive oxygen species (ROS) levels, GSH content, antioxidant enzymatic activities, and mRNA expression levels of oxidative stress-induced defense genes were analyzed using model marine copepod Tigriopus japonicus. The no observed effect concentration (NOEC) and median lethal concentration (LC50) of TCS in the adult stage were determined to be 300 μg/L and 437.47 μg/L, respectively, while in the nauplius stages the corresponding values were 20 μg/L and 51.76 μg/L, respectively. Fecundity was significantly reduced (P < 0.05) in response to TCS at 100 μg/L. Concentration and time-dependent analysis of ROS, GSH content (%), and antioxidant enzymatic activities were observed. The activity of catalase (CAT) and glutathione peroxidase (GPx) significantly increased (P < 0.05) in response to TCS exposure. Furthermore, mRNA expression of detoxification (e.g., CYPs) and antioxidant (e.g., glutathione S-transferase-sigma isoforms, Cu/Zn superoxide dismutase, catalase) genes was modulated in response to TCS exposure at different concentrations over a 24 h period. Our results revealed that TCS can reduce fecundity and induce oxidative stress with transcriptional regulation of oxidative stress-induced defense genes along with the activation of the antioxidant system in the copepod T. japonicus. Based on our investigation, TCS affects survival through oxidative stress with antioxidant and detoxification defense system in T. japonicus. In addition, two CYP genes (CYP3026A3 and CYP3037A1) are likely to have a potential role as biomarkers in response to TCS in T. japonicus. This study will be helpful for a better understanding of how TCS affects antioxidant defense and detoxification mechanisms in copepods.

292 The protective role of multi xenobiotic resistance (MXR)-mediated ATP-binding cassette (ABC) transporters in biocides-exposed rotifer Brachionus koreanus

Y. Lee, H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

In aquatic organisms, cellular membranes act as the final physical barrier to xenobiotics, since the membranes are in constant contact with the ambient water column that contains various anthropogenic pollutants. In this respect, the efflux activities of membrane transporters can be considered as the first line of defense of xenobiotics by exposure in aquatic organisms. ABC transporters, P-glycoprotein (P-gp) and multidrug resistance-associated protein (MRP) are ATP-binding cassette (ABC) transporters that confer multi xenobiotic resistance (MXR) via their efflux activity, which enables a variety of xenobiotics to be expelled from cells. MXR has been proposed as the first line of defense against xenobiotics. In this study, the protective roles of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chlorpyrifos, endosulfan, and endosulfan–furanolate) using fluorescent substrates and inhibitors specific to P-gp and MRP. The efflux activities of P-gp and MRP in the rotifer B. koreanus were increased by biocide exposure, since the fluorescence intensities of the accumulated P-gp and MRP fluorescent substrates were lower in response to different biocides. Thus, exposure of rotifers to the four biocides resulted in increased P-gp and MRP activity. Moreover, the rotifers became more sensitive to the biocides, with reduced survival and slower population growth rates, when P-gp or MRP was inhibited. These findings suggest that P-gp and MRP are involved in the defense response to biocide exposure. Furthermore, the transcriptional levels of the genes encoding P-gp and MRP were examined to uncover the mechanism by which MXR is induced. Taken together, our results demonstrate an important role of the MXR efflux system in the defense response to biocides, thereby providing a better understanding of rotifer defense mechanisms on the molecular level.

293 CRISPR/Cas9 genome editing generates Daphnia magna (loss of function) mutants for TRH and ABCB1 genes. Implications for (eco)toxicological testing.

C. Rivetti, IDAEA CSIC Barcelona / Environmental Chemistry; B. Campos, Unilever R&D / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; H. Watanabe, Osaka University / Biotechnology; Y. Kato, Osaka University / Department of Biotechnology; C. Barata, CSIC / Environmental Chemistry

Unravel the toxicological mode of action of pollutants to non-target keystone species may allow us to model and predict environmental risks of similar acting chemicals. OMICs technologies approaches developed in model
ecotoxicological species have allowed us to determine the mechanisms of action of many chemical contaminants. There is, however, the need for validated physiological studies applying reverse genomic tools. Here we present results on six CRISPR-Cas9 mutated *Daphnia magna* clones: three of them bearing mutations on the tryptophan hydroxylase gene (TRH), the rate limiting enzyme of serotonin synthesis, and another three having the transporter protein gene ABCB1 mutated. Bi- and tri-allelic del TRH mutants lack serotonin and have their growth rates impaired. Bi-allelic indel ABCB1 mutants had lower transcription activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoxetine indicated that effects of this drug enhancing offspring production was independent of serotonin. Acute toxicity test indicated that the transporter ABCB1 is involved in the detoxification of imvertin and its total or partial knockout dramatically increased its toxicity. These results provide the first evidence over the use of reverse genetics in *Daphnia* to study the mechanisms of action of toxicants opening new avenues of research in a stress physiology perspective. This work was supported by the Spanish Government grant (CTM2014-51985-R.)

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**Assessment of Effects and Recovery of Chaoborus Populations in a Novel-Concept Microcosm Experiment**

C. Gamblin, R. Cockcroft, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco

Larvae of *Chaoborus spp.* (phantom midges) which inhabit water bodies in the agricultural landscape are very sensitive to synthetic pyrethroid insecticides and are known to be one of the most sensitive taxon in microcosm studies. *Chaoborus* are holometabolous dipterans and from egg hatch, larvae develop through four aquatic instars before pupation and adult emergence. A concurrent study conducted on the same site (unpublished) elucidated that the species used in the study were multivoltine so *Chaoborus* have an almost all-year-round potential for re-colonisation. A new type of microcosm study was conducted to assess the extent and rate of recovery of *Chaoborus* populations in microcosms treated with a synthetic pyrethroid. Novel elements included spatial separation of treated and control systems by a distance of 100 m and non-invasive monitoring of larvae and pupae. The test material was applied at a single rate on two occasions with a 14-day interval to ten microcosms containing predominantly egg rafts and post-overwintering fourth instar larvae of *Chaoborus obscuripes*. Ten untreated microcosms with similar populations of *Chaoborus* were established upwind of the treated units and these, together with indigenous *Chaoborus*, served as a potential source of adult insects for re-colonisation of the treated units. Three microcosms in each group were covered with insect-proof netting to prevent natural re-colonisation in order to assess the extent of population recovery from within microcosms. The numbers and developmental stages of larvae along with the numbers of pupae and presence and numbers of egg rafts were monitored throughout the study using non-invasive methods, from the week before the first application in May 2017 to the end of August 2017. These assessment methods were successful in enumerating the larvae, pupae and extent of adult emergence over time. The findings from the study show that the early instar larvae of *Chaoborus* were impacted by treatments but that later instars were able to survive and pupate, and that adults emerge. Recolonisation was relevant to the ‘open-field’ given that the control microcosms were a substantial distance (100 m) from the treated microcosms. The results show that populations impacted by synthetic pyrethroids are re-established in less than 8 weeks after the first application.

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**Poster spotlight:** TU108, TU109, TU110

**Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (II)**

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**Linking chemical pollution and effects - How to identify drivers of toxicity?**

W. Brack, M.A. Hashmi, Helmholtz Centre for Environmental Research-UFZ / Effect-Directed Analysis; M. Koenig, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; M. Kraus, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; M. Muschket, UFZ- Helmholtz Centre for Environmental Research / Effect-Directed Analysis; m. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; T. Sorbera, Helmholtz Centre for Environmental Research / Cell Toxicology; C. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; C. di Paola, RWTH Aachen University / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Tindall, Watchfrog S.A.

European water resources are contaminated with complex mixtures of ten thousands of chemicals among them many non-regulated compounds emerging concern but also unknown chemicals. Chemical monitoring, however, typically considers only a very small fraction of chemicals focusing on 45 priority substances according to Water Framework Directive (WFD) together with some additional River Basin Specific Pollutants. These chemicals often do not explain effects in toxicity tests and impacts on freshwater communities. Thus, we suggest a consistent tiered approach to identify drivers of toxicity in complex environmental mixtures employing mass balance and multivariate statistical approaches as well as effect-directed analysis. The approach is demonstrated using several case studies in the Rivers Danube, Rhine, Meuse and Holtemme as examples. A specific focus is given on endocrine disruption and mutagenicity. While natural and synthetic steroids were confirmed to play a key role for endocrine disruption, the fluorescent dye Coumarin 47 has been identified as a so far unknown environmental pollutant with great anti-androgenic potency in vitro and in vivo. In a water body with direct impact of industrial effluents individual aromatic amines probably from dye production could be identified as the drivers of mutagenicity. In contrast, mutagenic effects detectable in the River Rhine receiving multiple contaminations from many sources were driven by mixture effects of industrial and natural compounds with low individual potency but strong synergistic effects when occurring together.

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**Toxic mixtures in time-the sequence makes the poison**

R. Ashauer, University of York / Environment

It is generally agreed that “the dose makes the poison”—that chemicals can be toxic or non-toxic depending on their dose. This principle assumes that once a chemical is cleared out of the organism (toxicokinetic recovery), it no longer has any effect. The impact of mixtures (Ashauer et al. 2013 CSIS EP-512:18) indicates that interactions, toxicodynamic recovery, which can be fast or slow. We tested four combinations of substances and found a clear difference in toxicity when the exposure order of two toxicants was reversed, while maintaining the same dose. When toxicodynamic recovery of the organism was slow relative to the interval between exposures it resulted in carry-over toxicity and so caused this sequence effect. We provide evidence for carry-over toxicity amongst chemicals acting on different targets and when exposure is several days apart. It is therefore not only the dose that makes the poison but also the exposure sequence.

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**How to deal with mixtures of pollutants in water resource management?**

R. Ahenbener, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Chemicals in the aquatic environment do not occur in isolation but as mixtures. Their compositions, concentrations and effects are highly dynamic with regard to their temporal and spatial occurrence. Current approaches of the EU water framework directive for assessing chemical and ecological quality do not reflect the emerging challenges. The SOLUTIONS project (Brack et al. 2015, STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Environmental monitoring systems (Brack et al. 2015, STOTEN 517:240) but there are options for utilising the advanced scientific knowledge for answers by either amending existing regulatory procedures of the EU water framework directive or by establishing novel assessment approaches. Priority mixtures can be conceived as a means to reduce the complexity of all real world situations into simplified archetypical scenarios. This might be achieved through modelling of typical ensembles from different common contaminant mixtures identified from chemical suspect pattern analysis. Identifying drivers of mixture risk can be tackled by various approaches all of which rely on a combination of chemical and biological information. Methods range from effect-directed analysis to compound class grouping by effect categories. To determine the impact of mixtures, multiple lines of evidence are emerging. They comprise of translating contamination information into expected adverse effect, effect-based monitoring using panel of bioassays and utilising trait-based parameters for analysing ecological monitoring data. In conjunction, they can be used to strengthen causal links between chemical and ecological status assessment. All these approaches were exemplarily tested within the SOLUTIONS project and should pave the way for improved water resource management.

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**A mixture risk assessment for pollutants that reach humans via the water – fish exposure route**

A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting

An important route for human exposures to substances present in freshwater is through the consumption of fish. To protect humans against this route of exposure, the WFD defines specific quality standards for priority substances. In general, combined exposures are not considered, with the exception of quality standards for mixtures of specific contaminant groups, such as polychlorinated dioxins (PCDD) or polychlorinated diphenyl ethers (PBDE). However, the possibility of combination effects across these pollutant groups is not currently considered. We present an advanced tiered mixture risk assessment for these groups of pollutants, first by using Water Framework Directive Quality Standards defined for PCDD and
An Advanced Methodological Framework for the Identification of Priority Pollutants and Priority Mixtures of Pollutants in European Freshwaters

T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; A. Arrenhius, University of Gothenburg / Biological and Environmental Sciences; R. Behra, Eawag / Department of Environmental Toxicology; T. Seiler, RWTH Aachen University / Ecosystem Analysis; P. van den Brink, Alterra and Wageningen University; B. Deutschmann, RWTH Aachen University / Department of Ecosystem Analysis ESA; N. Corcol, University of Gothenburg / Department of Biological and Environmental Sciences; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment; T. Teador, Eawag / Environmental Chemistry; H. Holter, RWTH Aachen University / Institute for Environmental Research; H. Segner, University of Bern / Centre for Fish and Wildlife Health; I. Teodorovic, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX); A. Tili, Eawag / Department of Environmental Toxicology; B. Wagner, Swiss Federal Institute of Aquatic Science and Technology (EAWAG) / Department of Ecotoxicology; T. Wagner, Swiss Federal Institute of Aquatic Science and Technology (EAWAG) / Department of Ecotoxicology

A toolbox for the detection of ecological impacts of chemicals was developed using a statistically supported, transparent and formalized weight of evidence (WOE) approach. It integrates four lines of evidence (LOE’s): (i) predictive mixture modelling, (ii) effect-directed analysis (EDA), (iii) in situ tests, and (iv) field-based monitoring studies. A systematic and quantitative method was developed for the aggregation of multiple in situ tests into LOE III, using an aggregated response index, which we termed the “average biomarker response” (ABR). The results of the four separate LOE’s are finally integrated using a systematic decision matrix that provides the main overarching conclusions that can be drawn from a given set of data and that pinpoints to critical data gaps. Here we first present an overview of the toolbox. Afterwards, we present a case study that used in situ experiments with phototrophic biofilms (periphyton) in wastewater impacted streams.

Chemical-analytical profiles initially showed clear differences of the micropollutant load in the water up- and downstream of the entry point of a sewage treatment plant effluent. These chemical-analytical data were evaluated for their potential ecotoxicological effects using the defined toxicological approaches. Based on outcomes of this LOE, we hypothesized that clear ecological effects on the structure and function of the exposed microbial communities should be present. Indeed, these were then confirmed using the concept of pollution-induced community tolerance (PICT). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecological impacts on the exposed microbial community (ii) a subsequent upgrade of the STP plant with activated carbon filtration led to a recovery of the community that was driven by a lowered overall toxic pressure, (iii) PSII inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfresh project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

Derivation, Validation and Implementation of Environmental Quality Benchmarks

Questioning annual average concentrations for plant protection products - TKTD modelling of real exposure profiles

M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG - EPF / Ecotox Centre; R. Kuhl, E. Zimmer, IBACON GmbH; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; R. Ashauer, University of York / Environment

The EU Water Framework Directive defines two environmental quality standards for assessing the chemical status of surface waters. The MAC-EQS defines the Maximal Allowable Concentration that should never be exceeded and the AA-EQS defines a concentration that should be exceeded by the Annual Average concentration. While the former should account for the acute toxicity of a substance, the AA-EQS is based on chronic eco-toxicity studies. For substances with highly fluctuating environmental concentrations like plant protection products the use of the annual average is disputed. Hence, in Switzerland it was suggested to use 14-day time-weighted average (TWA) concentrations for assessing compliance with quality standards for chronic toxicity. This approach is based on the average duration of chronic eco-toxicity tests and Haber’s rule. We assess the suitability of this approach for retrospective risk assessment by applying toxicokinetic-toxicodynamic (TKTD) modelling on high resolution exposure profiles of plant protection products measured in Swiss streams. The TKTD modelling is a proxy for the actual time-course of toxicity under time-variable exposure and is based on 7 species, 7 substances and 5 exposure profiles from 5 streams. The results confirm the suitability of the time integral of 14 days. The prediction of actual toxicity for the most toxic periods is very consistent with the toxicity modeled for the TWA. The deviations are on average less than factor 2 for each organism group tested. In addition to mortality for crustaceans and fish, only a small selection of sub-lethal effects was considered, namely reproduction and growth in water fleas and population growth in duckweed and algae. The results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is appropriate.

Revision of 62 Environmental Quality Standards - lessons learned

M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG - EPF / Ecotox Centre; R. Kase, Swiss Centre for Applied Ecotoxicology Eawag-EPFL; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

Environmental Quality Standards (EQS) are ecotoxicologically based threshold values that aim to prevent harmful effects of pollutants on ecosystems. Similar values exist in Switzerland and the Federal Office for the Environment recently commissioned the revision of existing EQSs for 62 substances to ensure that they are based on the current state of science. This study aimed to analyse the underlying reasons for numerical changes of EQSs and to highlight knowledge gaps. As for the original EQS derivation, relevant data were retrieved from databases, the public literature and bioassays to derive EQSs for all pollutants, provided by manufacturers. The reliability and relevance of ecotoxicological data were assessed using the CRED method. EQS derivation then largely followed the EU-Technical Guidance for Deriving EQS. After the revision, 60 AA-EQSs and 58 MAC-EQSs were proposed. The EQS revision did not generally lead to either lower or higher EQSs. AA-EQSs increased in 13 cases (max./median fold change +9.6/3) and decreased in 18 cases (60 AA-EQSs were increased in 21 cases (50.6/18) and decreased in 9 cases (22.7/2). Most EQS were derived deterministically, using the assessment factor (AF) method. Due to an increase in data for some
substances, the number of AA-EQs and MAC-EQs derived using Species Sensitivity Distributions (SSDs) increased from 2 to 5 and from 7 to 11, respectively. For AA-EQs derivation, AFs were reduced in 12 cases and increased in only 6 cases. For the MAC-EQs derivation, AFs were reduced in 5 cases and increased only in one case. Our study demonstrates that EQSs based on small data sets are more prone to large numerical changes when revised. Hence, an update often reduces variability associated with the derived EQSs, as evident from application of lower AFs and more frequent EQS derivations based on SSDs. This is likely to make EQSs more robust against larger changes in future revisions. Nevertheless, for the majority of the substances considered in this study, data sets were insufficient to construct SSDs. This is mostly due to a lack of studies using non-standard test species and species from important taxonomic groups, such as anhydrobioses or invertebrates. Additionally, on the mode of action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

304 Endocrine disrupting properties: how far and consistent they are considered deriving Water Framework Directive Environmental Quality Standards? A case study tackling French and EU EQS values
A. James-Casas, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances ETES; A. Bothamy, INERIS; S. Andrees, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances TAV; C. Gauvard, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances TAV. Group 4 considers that all chemicals should be tackled in diverse regulatory frameworks, among which the Water Framework Directive Common Implementation Strategy (WFD CIS). In this context, endocrine disruption (ED) is quoted several times as an issue for deriving water quality thresholds in the European Commission Technical Guidance for Deriving Environmental Quality Standards (TGD EQS). However, even if this guidance includes ED properties as a reason for growing concern, it does not properly recommend any specific methodological approach to consider these properties while deriving EQS values. In order to evaluate the usefulness of such a recommendation and the extent to which it should be implemented, a state of the art of how ED properties are currently been taken on board in the EQSs already derived at EU and national level was made. To begin with, the work consisted in carrying out an inventory of substances for which an EQS had been derived and a factsheet describing the reasoning behind value was available. These substances made up the universe of 178 substances on which further work was led. Then, an analysis was made of these substances EQSs derivation to categorise them according to how ED properties were reported and taken on board if necessary for protection of wildlife and human health. This work led to 4 groups of substances. Group 1 contains substances whose EQS values do not consider ED effects, and which need to be reassessed as a matter of priority. Substances for which EQS derivation has considered ED effects but whose rationale does not clearly explain this are grouped together in Group 2 and should be verified. Group 3 corresponds to substances whose ED characteristics have been considered by an additional safety factor and / or a study reviewed by ED experts. Group 4 considers that all chemicals should have ED effects demonstrated from now on. No action is required for these last two categories. This state of play and categorisation work made it possible to prioritise substances for which EQS should be updated first as regards their ED potential. Also, this work gives more insight in how to derive EQSs as regards ED potential in order to further propose recommendations for a harmonisation of the methodology in the future.

305 Brining water quality benchmark derivation approaches into the 21st century
K.A. van Dam, Environmental Research Institute of the Supervising Scientist / Department of the Environment and Energy; G.E. Batley, CSIRO Land and Water / Centre for Environmental Contaminants Research; R. Fisher, Australian Institute of Marine Science; D. Fox, Environmetrics Australia; A.J. Harford, Environmental Research Institute of the Supervising Scientist / Dept. of the Environment and Energy; C.L. Humphrey, Environmental Research Institute of the Supervising Scientist / Department of the Environment and Energy; A. Merrington, wca Environment Limited / Centre for Agroecology, Water and Resilience. The most common method for deriving water quality benchmarks (WQBs) for toxicants is the use of a species sensitivity distribution (SSD) to estimate a concentration above which a certain % of species will not survive. Although variations exist in the specific of the methods employed by jurisdictions around the world, the fundamental SSD approach is similar and, moreover, has not changed markedly over the past 20 years, despite a significant body of published research aimed at improving or developing new derivation methods. The recent revision of the Australian and New Zealand SSD-based derivation method has re-highlighted numerous limitations of the SSD approach for certain data situations and toxicant types; for example, small sample sizes, model choice and fit, and accommodating different routes of exposure (e.g. for persistent, bioaccumulative and toxic compounds) and specific mechanisms of toxicity (i.e. biomodality). However, areas for improvement of WQB derivation methods extend beyond just refining SSD-based approaches, to the use of non-SSD approaches and weight of evidence approaches that give consideration to both laboratory- and field-effects data. Other opportunities for improvement exist in the acquisition of data for WQBs (e.g. type and acceptability of toxicity data), as well as the application of WQBs in water quality management. Thus, it is important to identify and target the limitations that, if addressed, will yield the biggest benefits to environmental protection. Experience has shown that a ‘one size fits all’ approach to WQB derivation does not work, and an alternative is to provide flexibility and adopt approaches that do the best job in the face of the specific conditions and uncertainty posed by different situations. However, this may increase the complexity of the derivation process and, thus, decrease understanding and adoption by users. This presentation will examine a variable list of questions associated with WQB derivation: How can we address the veracity of that perception and attempt to understand its source. The current situation with the derivation of WQGs is that everyone has one and no single point for setting effluent discharge permits. Historically, most regulatory jurisdictions across the globe have, at the very least, WQGs for some trace elements. The perceived challenge for many in the regulated community, especially multinational organisations, is the lack of transparency in derivation and implementation of WQGs. To address this, the authors propose a step-wise method to improve EQS derivation, AF were reduced in 5 cases and increased only in one case. Our study demonstrates that EQSs based on small data sets are more prone to large numerical changes when revised. Hence, an update often reduces variability associated with the derived EQSs, as evident from application of lower AFs and more frequent EQS derivations based on SSDs. This is likely to make EQSs more robust against larger changes in future revisions. Nevertheless, for the majority of the substances considered in this study, data sets were insufficient to construct SSDs. This is mostly due to a lack of studies using non-standard test species and species from important taxonomic groups, such as anhydrobioses or invertebrates. Additionally, on the mode of action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

306 The quest for consistent environmental protection: the challenge of variable water quality guidelines between regulatory jurisdictions
G. Merrington, A. Peters, wca; S. Kosmala, WCA Environment Limited. This paper has been presented in previous stages. In this paper one will reassess the veracity of that perception and attempt to understand its source. The current situation with the derivation of EQS derivation has shown that a ‘one size fits all’ approach to WQB derivation does not work, and an alternative is to provide flexibility and adopt approaches that do the best job in the face of the specific conditions and uncertainty posed by different situations. However, this may increase the complexity of the derivation process and, thus, decrease understanding and adoption by users. This presentation will examine a variable list of questions associated with WQB derivation: How can we address the veracity of that perception and attempt to understand its source. The current situation with the derivation of WQGs is that everyone has one and no single point for setting effluent discharge permits. Historically, most regulatory jurisdictions across the globe have, at the very least, WQGs for some trace elements. The perceived challenge for many in the regulated community, especially multinational organisations, is the lack of transparency in derivation and implementation of WQGs. To address this, the authors propose a step-wise method to improve EQS derivation, AF were reduced in 5 cases and increased only in one case. Our study demonstrates that EQSs based on small data sets are more prone to large numerical changes when revised. Hence, an update often reduces variability associated with the derived EQSs, as evident from application of lower AFs and more frequent EQS derivations based on SSDs. This is likely to make EQSs more robust against larger changes in future revisions. Nevertheless, for the majority of the substances considered in this study, data sets were insufficient to construct SSDs. This is mostly due to a lack of studies using non-standard test species and species from important taxonomic groups, such as anhydrobioses or invertebrates. Additionally, on the mode of action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

307 A Call for Greater International Collaboration in Developing Environmental Quality Benchmarks: Many Hands Make Lighter Work!
M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science; G. Merrington, wca Environmental quality benchmarks (EQBs, also variously called guidelines, standards, criteria) are an internationally accepted means of protecting ecosystems from the adverse effects of toxicants. As such, numerous countries, states/provinces, regions, academics and consultants have developed EQBs. As a result there are numerous EQBs for the same suite of chemicals (e.g. copper, lead, benzene), each slightly different. This is a huge waste of resources. These differences arise because of the differences in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the magnitude of assessment factors etc. The current situation with the derivation of EQBs has been compared to that of toothbrushes – “everyone has one and no one else wants to use anyone else’s” and disagreements arise about whose “toothbrush” is the best, whether particular features are desirable, and how to update WQG and account for new scientific developments. There are unfortunate repetitive cycles of derivation that each jurisdiction goes through for the same substances and perhaps there is benefit in sharing knowledge and understanding across jurisdictions that would deliver consistent and transparent levels of environmental protection.
Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring

308 The impact of anthropogenic activities on bacteria and viral diversity in the Eastern Mediterranean Sea
A. Tsiora; P. Pitta, Hellenic Centre for Marine Research Crete / Institute of Oceanography and Environment; S. Fodianakis, G. Michoud, King Abdullah University of Science and Technology; A. Pavlidou, E. Rousselaki, N. Simbou, Hellenic Centre for Marine Research; C. Zeri, Hellenic Centre for Marine Research / Institute of Oceanography; I. Karakashis, University of Crete / Department of Biology; G. Kotoulas, Hellenic Centre for Marine Research; D. Daffonchio, 4King Abdullah University of Science and Technology / Biological and Environmental Sciences and Engineering Division; M. Tsapakis, Hellenic Centre for Marine Science / Institute of Oceanography

The Eastern Mediterranean Sea is a low-nutrient low-chlorophyll marine ecosystem [1] but some variability within the basin does exist. Indeed, several coasts are influenced by anthropogenic processes, and specifically in the Greek coasts these include industrial, harbor, agriculture, mariculture activities, urbanization and tourism [2]. Our hypothesis was that prokaryotic and viral community diversity is differently affected in contrasting coastal systems by anthropogenic pressures. We used 16S rRNA gene amplicon and whole virome sequencing at stations characterized by different chemical features based on the “Environmental monitoring project for the implementation the Water Framework Directive (2000/60/EE) in Greece” [2]. We focused on viral auxiliary metabolic genes and the influence of heavy metals (Cu, Cd, Co, Ni, Pb, Zn, Cr and Hg). Significant differences were found at the genus level between the sampling stations. Proteobacteria were dominant in all stations, while Bacteroidetes were more pronounced in some of the stations. Rare phyla were higher in Echinades and Patraikos Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cd, Cu and Pb. The highest concentrations of NO2-, NO3-, NH4+, PO43-, SiO2 and chlorophyll a were found in stations influenced by extensive industrial, agricultural and maricultural activities. The 3 stations of Amvrakikos Gulf were highly variable in terms of community structure. Significantly lower relative abundance of Verrucomicrobia and Bacteroidetes in the “control” than in the “impact” station in Kefalonia (inside and outside the influence of the fish farms, respectively) was seen. Bacterial 16S rRNA analysis revealed significant differences between stations along the Greek coast, suggesting that each station hosts a different community. Analysis of viral metagenomes will show if community composition reflects the anthropogenic activities in these areas, and if lysogeny (i.e. viral integrase and auxiliary metabolic genes’ abundance) is a prevalent life strategy. [1] Krom MD, Emeis K-C, Van Cappellen P. 2010. Why is the Eastern Mediterranean phosphorus limited?. Prog Oceanogr 85:236-244. [2] Pavlidou A, Simbou N, Rousselaki E, Tsapakis M, Pagou K, Drakopoulou P, Kostyianis H, Panayotidis P. 2015. Methods of eutrophication assessment in the context of the water framework directive. Cont Shelf Res. 108: 156-168.

309 Impacts of stormwater on microbial community structure and function in estuarine sediments
K. Houghton, Macquarie University / Evolution and Ecology Research Centre; P. Steinberg, University of New South Wales / Centre of Marine Biotechnology; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; J. Potts, P. Scanes, NSW Office of Environment and Heritage; S.C. Birrer, University of New South Wales; M. Sutherland, NSW Office of Environment and Heritage; V.X. Sim, University of New South Wales; T. Lachnit, University of Kiel; S. Swarup, National University of Singapore; S. Kjelleberg, Nanyang Technological University / The Singapore Centre on Environmental Life Sciences Engineering; M. Doblin, Department of Environmental Sciences / Department of Environmental Sciences; G. Birch, Sydney University / School of Geosciences; P. Gribben, University of New South Wales; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre. Estuaries are diverse and productive ecosystems that are subject to high levels of disturbance. They are exposed to multiple stressors such as legacy contaminants in sediments and ongoing inputs of nutrients and metals via stormwater, but we still have little understanding of the consequences for ecosystem functioning. We surveyed sediment communities at four locations with large stormwater drains in Sydney Harbour, Australia. Locations were either poorly-flushed embayments or well-flushed estuarine channels. Sediment cores were collected monthly during base rainfall (< 5mm/day) for 4 months from 5 sites within each location at increasing distance from the stormwater drain (0, 200 and 1000 m). We also collected sediments after 2 large rain events (>150mm in 24h). Next-generation sequencing was used to characterize the microbial community and sediment was subsampled for metals, total organic carbon, total nitrogen and phosphate. Sediment cores were also collected for chemical processes including primary productivity, community respiration and nutrient cycling. We observed major shifts in the microbial community related to exposure to legacy contaminants and new stormwater contaminant inputs. We also found trends of decreasing community respiration rates away from storm drains and lowest rates of primary production during base rainfall. The results have implications for future management of stormwater in estuaries and increase our understanding of how to conserve crucial sediment community diversity and function.

310 Drought as environmental driver on ciliates and micrometazoa communities in a multistressors scenario. An experimental approach
J. López-Duval, F. Romero, V. Acuña, S. Sabater, ICRAN Catalan Institute for Water Research
Climate change will affect agriculture practices and productivity because increased inter-annual and seasonal variability in rainfall and temperatures, altered hydrological regimes and changes in phytology, that means a future increase in the use of pesticides and, in consequence higher risk of freshwater pollution. In addition climate change will lead to higher severity of drought events and higher temperatures. Ciliates and micrometazoa in freshwater ecosystems play an important role in the processing of organic matter and as basal resource for consumer organisms. The present work aims to study how these environmental and chemical stressors, and their interactions, in a future scenario of climate change can affect these communities in freshwater sediments. To study how drought (D), warming (T) and a realistic environmental mixture of pesticides (P) can affect the communities of ciliates and micrometazoa in river sediments, we developed an experiment with a factorial design in experimental indoor channels with natural sediment from a pristine river (24 channels, 3 replicates, 3 study species and 5 concentrations). The community was exposed to the stressors for 7 weeks. Diversity of Ciliophora and micrometazoa communities was studied twice during the experiment (one week before and after 7 weeks of chronic exposure). Significant changes in community composition between pre- and post- exposure were observed for all treatments. Community was dominated by micrometazoa in all treatments in terms of density, but a trend of increasing the percentage of ciliates in those treatments with stressors was observed, indicating a possible advantage of ciliates in stressed environments. At the end of the experiment total density was significantly higher respect to control in D, DP and TDP treatments (p < 0.001 Dunnet’s test) while diversity was significantly higher in D, TD and TP conditions (p < 0.001 Dunnet’s test). Taking into account the community function, the most important factor causing significant differences in community composition (PERMANOVA p < 0.001). The mixture of pesticides at realistic environmental concentrations did not cause any effect on the studied communities. Our results suggest that flow reduction is the main driver for changes in micrometazoa and ciliates communities in our experimental system while pesticides and temperature produce significant effects only in combination with drought.

311 Linking pesticide pollution with periphyton quality in agricultural streams: a fatty-acids approach
N. Corcelli, University of Gothenburg, Sweden / Biological and Environmental Sciences; Håkansson J, University of Gothenburg / Department of Biological and Environmental Sciences; A. Nilsson, University of Gothenburg / Section of Ophthalmoogy. Dept. Clinical Neuroscience, Institute of Neuroscience and Psychology, Sahlgrenska Academy; K. Johansson, University of Tartu / Institute of Technology; H. Spångfors, Halmstad University; M. Kahler, SLU Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; J. Kreuger, Swedish University of Agricultural Science / Centre for Chemical Pesticides; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences. Although the environmental risks associated with pesticide pollution in agricultural streams are quite well documented, little is known about its potential effects on periphyton quality. Periphyton provides many of the essential polyunsaturated fatty acids (PUFA) that are needed for organisms at higher trophic levels in river food webs. This study aims to assess the effects of pesticide mixtures on periphyton quality in situ. Three streams (Höje å, Skivarpsån and M42) located in the agriculturally dominated region of Skåne (SE Sweden) were sampled in September and October 2016. The effects of pesticide pollution were assessed by passive field sampling coupled with laboratory ecotoxicity tests, by mixture toxicity modelling to predict which chemical stressors were potentially driving the toxicity, and, by examining the fatty acid profiles, pigment content and algal diversity of periphyton communities. Results from water chemical analyses clearly showed higher levels of nutrients and pesticide pollution in Skivarpsån and M42 than in Höje å. Ecotoxicity tests using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpsån and M42 were toxic for periphyton communities from Höje å, causing an inhibition of the photosynthetic activity up to 63% and 53%, respectively. Cluster and principal component analyses based on pigments content, algal diversity and fatty acid profiles, clearly separated the periphyton from the three river sites studied. Algal biomass from periphyton of pesticide polluted streams (Skivarpsån and M42) was higher than in Höje å. The nutritive quality of the periphyton differed among streams, and fatty acids considered high-quality such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were also more abundant in pesticide polluted streams (Skivarpsån and M42). Overall, even though results from the lab show that the mixture of pesticide pollution in the studied
Our presentation will give an overview of the extended model and related datasets, improving the quality and hence reducing uncertainties in LCA studies worldwide. The model was used to develop new country-specific primary metals production in order to demonstrate the important differences between global average and situation-specific calculations in such an important sector as primary metals production.

Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction

Laurenz Albrecht, Alma Mater Studiorum - University of Bologna; F. Passarini, Alma Mater Studiorum - University of Bologna / Dept. of Industrial Chemistry

Copper is widely used in modern society, finding application in traditional end-uses such as plumbing, infrastructure, and transportation, but it is also an essential material in emerging green energy technologies. Europe (i.e., EU-28) has modest natural deposits and strongly depends on imports to meet the domestic demand. In order to improve resilience and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling economy function was not economic indicators were calculated to evaluate the resulting energy savings and greenhouse gas emissions reduction. The results show that copper recycling can contribute significantly to reduce the energy requirements and mitigate greenhouse gas emissions associated with the regional copper industry. However, for three out of the four scenarios the current recycling performance seems not to be enough to close the copper cycle. Fundamental constraints are likely to limit the implementation of a circular economy unless dramatic changes occur in the current pattern of copper production, consumption and recycling at end-of-life.

Multi-Objective Reverse Supply Chain Network Design of Fluorescent Lamps with Piecewise Linear Functions

C. Lee, L. Papageorgiou, University College London / Department of Chemical Engineering; N. Shah, Imperial College London / Department of Chemical Engineering

In this study, a reverse supply chain model has been developed to support strategic decisions making problems associated with its network design and reverse operation. The examined networks comprise multi-echelons, including disposer markets, collection facilities, recycling plants and reuse markets connected by a transportation mode. The system is modelled as a multi-objective mixed-integer linear programming (MILP) optimisation problem allowing the inherent trade-offs between the conflicting economic and environmental objectives to be explored. The economic function is not economic indicators were calculated to evaluate the total cost the resulting production savings. Total cost includes capital and operation costs required to operate the supply chain network. The production saving is the revenue obtained from selling secondary products. In contrast, the ecological objective function is based upon net environmental value. This is achieved by adopting the principles of LCA, expanding the network boundaries to incorporate a set of life cycle stages and using the Korean Eco-Labelled products. The objective function is decomposed into the network and avoided burdens. In addition, the environmental and economic performances of reverse supply chain networks are assessed through the development of a spatially explicit model that combines logistics and Geographic Information Systems. The model is used to address strategic decisions involving the location, number and capacity of collection and recycling facilities; collection of recycling technologies; and assignment of transportation links required to satisfy returns and demand at the markets. At the operational level, optimal recycling profiles and flows of material between various components within the supply chain are determined. Furthermore, the model considers the economies of scale (large, medium and small) of collection & recycling facilities and transportation links, and explores whether centralised recycling is favoured over decentralised recycling. The optimality of the proposed models is explored within a South Korea context in order to determine the optimal reverse supply chain configuration of fluorescent lamps.

The use of Life Cycle Assessment to adjust consumption taxes: The concept of a Damage and Value Added Tax

B. Timmermans, Université Libre de Bruxelles; W. Achten, Université Libre de Bruxelles / Department Geosciences, Environment and Society

The purpose of this presentation is to provide a short insight about a study examining the principles and feasibility of a shift from Value Added Tax (VAT) or sales tax to a Damage and Value Added Tax (DaVT) partially based on the life cycle assessment of products and services. With this shift, goods and services that seriously harm the environment and human health will be priced up, those that have less impact will be priced down. The DaVT system relies on three essential
points: i) Apply VAT (or consumption taxes in general) to all goods and services and reduce its multiple rates to one single low rate (e.g. 3%) called Uniform VAT (UVAT); ii) Add to UVAT a per-unit tax called Global Damage Tax (GDT) calculated on the basis of environmental impacts assessed by means of specific or generic LCAs. In the case of potentially high-polluting products or industries, a specific LCA will be automatically imposed; iii) In order to reflect environmental, social or ethical concerns specific to a country, another damage tax termed Specific Damage Tax (SDT) is proposed that extends beyond LCA. DaVAT is the sum of UVAT, GDT and SDT. DaVAT is conceived not as an additional burden but rather as a shift of taxation, as the rate of the old consumption taxes can decrease proportionally to the increase of GDT. DaVAT is also designed in such a way that the erosion of tax revenues, when pollutant releases would be offset by the extension of the tax to all goods and services and by the possibility to gradually re-increase the VAT rate when the number of highly-polluting products decreases. To reduce the variance of the LCA results used for this purpose, the DaVAT system should use common databases, apply the same inventory, characterization, normalization and weighting methods, as well as refer to the same impact categories and the same cut-off rules. LCA as a whole can stay as it is, but for use of DaVAT specific impact categories (e.g. calculate changes in assessment based on previous studies has been made of the costs of implementation, maintenance, administration and compliance of DaVAT, as well as of the risks of fraud, price changes and acceptability of the proposal. The presentation shall briefly outline the results of this assessment.

318 Towards global guidance on LCA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force

T. Sondergeger, ETH Zurich; M. Berger, Technische Universität Berlin / Chair of Sustainable Engineering - Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Bach, Technische Universität Berlin / Chair of Sustainable Engineering; A. Cimprich, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, treexe Ltd.; J. Guinee, University of Leiden / Institute of Environmental Sciences; C. Helbig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHITA, National Institute of Advanced Industrial Science and Technology; S. Northeij, Monash University; Another damage tax termed ISM; L. Tikana, DKI Copper Alliance / Life Cycle; A. Valero, Universidad de Zaragoza; M. Vieira, PRe Sustainability; S. Young, University of Waterloo

Primary mineral resources are of great relevance for industry and society. The environmental impacts caused by emissions to air, water, and soil resulting from mining and refining processes to produce usable materials are considered in relatively few LCA specific impact categories (e.g. calculate changes in assessment based on previous studies has been made of the costs of implementation, maintenance, administration and compliance of DaVAT, as well as of the risks of fraud, price changes and acceptability of the proposal. The presentation shall briefly outline the results of this assessment.

330 Silica coating for the control of nano-reactivity

S. Ortelii, CNR ISTE; M. Blosi, CNR; D. Gardini, CNR ISTE; A. Costa, CNR

Silica coating for the control of nano-reactivity

S. Ortelii, CNR ISTE; M. Blosi, CNR; D. Gardini, CNR ISTE; A. Costa, CNR

Silicon dioxide (SiO2) and nano-silver (Ag) and are among the materials most investigated for their technological importance and consequent interest in terms of their environment, health and safety (EHS) issues. In particular these particles cause alert for their capacity to generate, transport and release potentially toxic elements such as metal ions and reactive oxygen species that can induce several negative effects, responsible for cytotoxicity. In this study we investigated silica coating as technique for control two recognised toxicity drivers for nano TiO2 and Ag that are the exogenous production of ROS and the Ag+Ag total distribution. We evaluated the effect that silica coating had on physicochemical properties (size, shape, and in vitro potential) only and bioavailability and biocompatibility of these materials. We first demonstrated that both at colloidal and dried state a matrix of SiO2 surrounding TiO2 and Ag nanoparticles was formed, even by simply playing with colloidal attraction between the two hetero-phases. The presence of silica coating seems to have two important effects for the control of ROS and Ag+ toxicants, representing a safe by molecular design solution for the control of nano-reactivity. 1) Silica acts as dispersing/diluting matrix for, decreasing the production of ROS, but improving the photocatalytic performances of pristine sample; 2) Silica act as reservoir for Ag+ ions, decreasing the amount of immediately available fraction and so improving the range of concentration where the sample shows antibacterial properties despite to negligible cytotoxicity.

321 Framework for the optimal design of sustainable chemical processes

A. Gonzalez Garay, R. Calvo-Serrano, G. Guillin Gosálbez, Imperial College London / Chemical Engineering

Given its natural link between fundamental science, engineering and industrial practice, the chemical industry plays a key role in meeting the challenges of sustainable development. In particular, the use of computer aided tools for the generation of sustainable processes is essential to facilitate the transition towards a more sustainable chemical industry. In this work, we present a framework that incorporates sustainability principles in the design of chemical processes. The methodology proposed uses life cycle assessment to assess the sustainability of the processes; surrogate modeling and objective-reduction techniques to enhance the optimization of the processes; and data envelopment analysis (DEA) as multi-criteria analysis tool. The use of DEA facilitates the post-optimal analysis of the Pareto front by filtering and ranking the optimal designs that conform the Pareto frontier without the need to define explicit weights. In addition, DEA provides improvement targets for suboptimal alternatives that if attained would make them optimal. The methodology of this study allows industries to establish maximally efficient and sustainable processes.

332 A decision framework for substances of very high concern at the interface of chemicals, products and waste


Reuse and recycling of products are key elements towards a sustainable and circular economy. Especially the circular economy policy, a non-toxic environment is being pursued as well. Care should be given to the reuse and recycling of waste streams containing substances of very high concern (SVHC). Ideally, the presence of SVHCs in the design and production phase should be prevented by applying Safe-by-Design alternatives. However, we have to realize that we are still in an era in which we are faced with numerous (legacy) SVHCs in waste streams. For these waste streams, safe ‘end-of-life’ solutions have to be found in order to stimulate the circular economy and safeguard a non-toxic environment. Within this study, we developed a generic framework to decide how waste streams with legacy SVHCs should be managed. The framework is specifically developed for the licensing process and provides guidance to license applicants and license authorities in the Netherlands. By following the framework, it will indicate whether the recycling of a specific waste stream into a specific end-product can be considered as acceptable with respect to the SVHC content. In principle, the use of this framework consists of three steps: 1) identification of SVHCs in the waste stream; 2) a basic decision scheme in order to decide whether a more elaborate risk analysis is necessary or whether the risks can be considered as acceptable; and 3) a risk analysis. Within the risk analysis, the acceptability of recycling will be assessed by weighing various aspects, including: availability and feasibility of SVHC removal possibilities, exceedance of SVHC concentration limit values, potential SVHC exposure of man and the environment, and the traceability of the material stream (including SVHC) during the whole life cycle. This framework is a first step to improve and warrant safe and sustainable recycling of waste streams. Future adjustments of this framework will be required in upcoming years based on practical experiences of

Safe by Design: responsible and innovative research for safe and sustainable chemistry

Poster spotlight: TU214, TU215, TU237
licensing authorities. Furthermore, it is advised to develop a broader decision scheme that besides SVHCs also considers and weighs other risk and benefit factors of recycling, like the risk of pathogens and medicine residues and the benefits with respect to sustainability (e.g. carbon footprint). Such a development will further stimulate the transition towards a safe and sustainable economy.

323 Emotions of PFASs and alternatives from the durable water repellence layer (DWR) of textiles during use
Ly Veen, Institute for Environmental Studies (IVM) VU University Amsterdam / Chemistry and Biology; A. Hanning, Swerea IVF AB; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); J. de Boer, Vigeo Eiris Amsterdam Department Environment & Health / Environment and Health; J. Weiss, Stockholm University, ACES / Department of Aquatic Sciences and Assessment; P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health
In the durable water repellence (DWR) layer of textiles of outdoor clothing, PFASs have been used because their perfluoroalkyl chains have the ability to repel liquids of a wide range of polarities (e.g. water, sweat, and other clothing). DWR compounds, like PFASs and silicones are emitted to air, as well as to rain water and washing water. During the use phase of outdoor clothing, DWR chemicals are emitted to the environment.

324 Chemicals in plastic packaging: Prioritization of hazardous substances
K. Groth, Food Packaging Forum Foundation; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences; B. Geuene, Food Packaging Forum Foundation; A. Lennquist, Chemsec; H. Leslie, VU University Amsterdam / Environment & Health; I. v. Veen, Institute for Environmental Studies / Department of Environment and Health
In the DWR of textiles during use are assessed in comparison with the long-chain PFASs. As part of the SUPPES project we perform chemical alternative assessment including application hazards, exposure and life-cycle assessment studies. One of the studies focuses on the emissions of PFASs from outdoor clothing vs. emissions of alternative DWR chemicals such as short-chain PFASs (e.g. C4, C6) and silicones. We study the emissions using different emission scenarios which are based on real-life situations such as leaching to rain water, emission to air, weathering and turning dry. Within the SUPPES project different types of formulations, PFAS-based as well as silicon-based, have been applied to two different types of textiles, i.e. polyamide (PA) and polyester (PES). After testing the water repellence properties, a selection of four PFAS-based textiles and three silicon-based textiles have been used for assessing the emission of PFASs and silicones. For chemical alternative assessments it is highly important to include proper application tests in combination with experimental emission exposure scenarios. This information will provide valuable information to aid selection of safer alternatives. The emissions of chemicals out of the DWR-treated textiles are not only depending on the type of DWR, but also on the type of textile used. Weather conditions, like sunlight, high temperature, or humidity can have a strong effect on the emissions. For example, under high temperature and humidity conditions, PFASs and silicones are emitted to air, as well as to rain water and washing water. During the use phase of outdoor clothing, DWR chemicals are emitted to the environment.

325 A Safe by Design framework to support the development of sustainable nano-enabled products for the restoration of works of art
E. Giubilato, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; M. Picone, D. Hristozov, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; M. Picone, D. Hristozov, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. Marcomini, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics

Innovative nano-enabled products can overcome some issues of the traditional restoration techniques, especially in the case of complex and unstable materials used in contemporary artworks. However, nanomaterials have been demonstrated to be potentially hazardous to both humans and the environment. Their application for the conservation of cultural heritage requires a proper assessment and management of potential risks. A Safe by Design (SbD) approach can support the early identification and management of uncertainties and risks during an innovation process and allows for the modification of a product design to avoid undesired properties. Within the EU H2020 “NANORESTART” project, a stepwise SbD framework for the sustainability assessment of nano-based products for restoration has been proposed, taking into account the current EU legislative context as well as the specific features of the innovation process in the restoration field. The proposed framework embraces the SbD concept proposed by NANOREG initiative, which uses the Cooper Stage Gate innovation model as backbone to incorporate SbD in structured innovation management processes for nanomaterials. Six steps build up the framework: (a) state-of-the-art assessment, (b) initial formulation, (c) screening hazard assessment (based on CLP self-classification approach for mixtures), (d) advanced hazard assessment (based on the development of an Intelligent Testing Strategy (ITS)), (e) safety assessment (including the definition of Risk Management Measures), and (f) sustainability assessment (where environmental, social, economic and technical criteria are integrated to compare new to conventional products). The framework is focused on application and post-application stages, while the manufacturing stage cannot be included until the industrial up-scale has been finalized. The SbD framework is currently being applied to NANORESTART advanced nano-based formulations for controlled cleaning and surface protection and consolidation. A specific ITS has been defined, including three biochronic toxicological tests, (i) aquatic toxicity, (ii) a set of tests for cytotoxicity, DNA-damage and mutagenicity. Moreover, specific leaching test protocols are being applied to investigate medium and long-term behaviour of products in post-application stages. The results of the framework application to the most promising formulations will be presented and discussed in detail.

Recent developments in environmental risk assessment for pollinators

326 Managing on the Margins: The confluence of Modern Agriculture and Aiculture
Z. Browning, Browning's Honey Co., Inc.
In the USA, beekeeping is a hobby, a sideline business, and commercial enterprise. Pollinating our backyard gardens, and local communities is made possible by backyard beekeepers with one hive or more. Beekeepers who aspire to increase their honey production, and crop pollination may have hundreds of hives serving not just their local communities, but their state or regions of the country renting their hives to pollinate specialty crops. Commercial beekeepers migrate with their tens of thousands of colonies to pollinate the nation’s food supply. Once commercial bees have pollinated the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture endures, the urban to rural boundary between the urban and the environment. Pest and pathogens of honey bees are real challenges regardless of location. Habitat loss and pesticide exposure to bees, are greater variables, but no matter what general shared land use is considered for bee hives there are potential conflicts. In each and every case, there are also opportunities to work together with partners and stakeholders for mutually beneficial outcomes. Whether it is water issues, soil management, or bee health, the use issue is the underpinning of the entire bee health. In the past, beekeepers, pesticide manufacturers must address how the end user interprets the directions for use, and the cultural practices of the products. Regulatory agencies must acknowledge the pesticide end user’s cultural practices of tank mixing pesticides, of fungicide and herbicide impacts upon pollinators, and to combine their agency efforts to protect the entire farm, not just each single crop from each single pest. Sustainable land management will allow pollinator-friendly food production or protection of human and animal health from disease vectors must be coordinated to ensure profitable production outputs for all stakeholders. Beekeepers can assist in the development of
scientifically supported risk assessment through participation in research development. Beekeepers know bees; researchers know research protocols. To understand how honey bees function under migratory beekeeping and crop field conditions beekeepers need to be part of designing the risk assessment research. Beekeepers, no matter the level of beekeeping or number of hives, are eager to be included in research that will help alleviate the risks to honey bees, and native pollinators. Inviting beekeepers in risk assessment and research design is key to ensuring the research premise and results truly reflect the real-world of beekeepers and honey bees. In some ideal world beekeepers would be respected for the ecosystem service their honey bees provide to farmers. Beekeeper and farmer would understand their symbiosis in connection with the health of the crop, and the success of the crop’s yield. Both would work to ensure a healthy crop and healthy honey bees to pollinate all crops. One begets the other; each supporting each other: beekeeper and farmer, honey bee and crop (personal examples). As such all stakeholders who rely on honey bees and native pollinators to maintain a healthy ecosystem would balance competing interests to ensure pollinators have clean, plentiful, and diverse forage, pollinators are healthy to provide appropriate pollination services to the ecosystem, and land management is facilitated to reduce soil erosion, protect water, and reduce the threat of disease vectors. (share Bee and Butterfly Fund programs as results)

327 A new multi-dimensional method for evidence synthesis and weighting in bee risk assessment


In recent years, neonicotinoid substances have often been in the spotlight, particularly due to their effects on bees. Reporting of highly contradictory results catalysed much attention from the scientific community. The great amount of available studies requests approaches able to ensure an effective integration of the available data. To this purpose, EFSA has developed a novel approach for the most recent conclusions on imidacloprid, clothianidin, and thiamethoxam. Risk due to exposure of bees from residues in pollen and nectar of treated crops is used here as a case study to illustrate the methodology. Oral exposure was estimated by combining data on residue levels in pollen and nectar and estimation of bee food consumption. Together with exposure data, higher tier effect data were the focus of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific topic. The exercise combined systematic reviews and weight or evidence, sharing many aspects with meta-analysis techniques. The approach used in this assessment addressed some issues that commonly undermine the reliability of meta-analysis such as the so-called ‘file-drawer’ problem. Overall, the presented approach ensured significantly more transparency than a fully qualitative expert judgment-driven assessment, but still allowed considering several dimensions in a quantitative manner, removing a priori assumptions and simplifying the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining important qualitative information.

328 PESTICIDE EXPOSURE ASSESSMENT PARADIGM FOR BUMBLE BEES

J. van der Steen, Alveus AB Consultancy; C. Cutler, Dalhousie University / Faculty of Agriculture; D. Goulson, School of Life Sciences, University of Sussex; A. Gradish, Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais; A. G. Rossa-Fontana, Unesp - Instituto de Biologia / Departamento De Biologia, Centro de Estudos de Insetos Sociais; R. Cornelio Ferreira Nocelli, Universidade Federal de São Carlos UFSCar Araras / Ciências Biológicas Departamento de Ciências da Natureza Matemática e Educação; O. Malaspina, UENSP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais; A. Alix, Dow Agrosciences / Risk Management; J. C. E. Pilling, Dow AgroSciences; R. Sharp, C. Szentes, D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit

The exposure of the bumble bee (Bombus sp.) to pesticides is a potential area of conflict between Environmental Safety B. O'Neill, DuPont Crop Protection; N.E. Raine, C. Scott - Environmental Safety and the European industry. The bee protection is an integral part of agriculture and the use of pesticides, and may be catalysed much attention from the scientific community. The great amount of available studies requests approaches able to ensure an effective integration of the available data. To this purpose, EFSA has developed a novel approach for the most recent conclusions on imidacloprid, clothianidin, and thiamethoxam. Risk due to exposure of bees from residues in pollen and nectar of treated crops is used here as a case study to illustrate the methodology. Oral exposure was estimated by combining data on residue levels in pollen and nectar and estimation of bee food consumption. Together with exposure data, higher tier effect data were the focus of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific topic. The exercise combined systematic reviews and weight or evidence, sharing many aspects with meta-analysis techniques. The approach used in this assessment addressed some issues that commonly undermine the reliability of meta-analysis such as the so-called ‘file-drawer’ problem. Overall, the presented approach ensured significantly more transparency than a fully qualitative expert judgment-driven assessment, but still allowed considering several dimensions in a quantitative manner, removing a priori assumptions and simplifying the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining important qualitative information.

330 Standardization of an in vitro larval rearing method for stingless bee species Melipona scutellaris for use in toxicological bioassay studies

A.S. Dorigo, Universidade Estadual Paulista Júlio de Mesquita Filho Unesp Rio Claro - Departamento De Biologia, Centro de Estudos De Insetos Sociais; A. G. Rossa-Fontana, Unesp - Instituto de Biologia / Departamento De Biologia, Centro de Estudos de Insetos Sociais; R. Cornelio Ferreira Nocelli, Universidade Federal de São Carlos UFSCar Araras / Ciências Biológicas Departamento de Ciências da Natureza Matemática e Educação; O. Malaspina, UENSP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais; A. Alix, Dow Agrosciences / Risk Management; J. C. E. Pilling, Dow AgroSciences; R. Sharp, C. Szentes, D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit

Bombus Apis mellifera is the species of bumble bee species which presents a threat to Brazil’s agriculture industry; it can potentially damage important crops as eggplant, tomato and sweet pepper. Thus, the present study aimed to propose an in vitro larval rearing method of A. mellifera, since this species is well characterized and is used for risk assessment studies, in order to standardize the Brazilian fauna, species from the same genus are recognized as effective pollinator of important crops as eggplant, tomato, and sweet pepper. The potential exposure routes and actual exposure of the bumble bee queen, workers and larvae are mapped and knowledge gaps are identified. The honey bee is used as the reference point to which the differences in biology, foraging and nursing behaviors are compared. Some significant differences in susceptibility to pesticides between Bombus species have also been identified. It is concluded that there are significant gaps in current knowledge for bumble bee species on both realistic levels for some key exposure routes and cumulative exposure that are not accounted for in the current Apis risk assessment protocols.
the progress of the experiments, increasing from 67.1% in the first to 87.8% in the latter, and the morphometric analyses indicated newly emerged workers in vitro with similar sizes to in vivo. The in vitro rearing method described showed a satisfactory survival rate, as well as produced newly emerged workers with similar to those from natural conditions, allowing its use in toxicity tests.

331 Poster spotlight: TU038, TU048, TU052

Understanding human and environmental exposure to chemicals in urban systems

332 Consumption of products - a proxy for changes in chemical flows in urban areas and to the environment?

E. Undeman, D. Boltinis, Stockholm University / Baltic Sea Centre; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. Löf, Stockholm University / Baltic Sea Centre

Is the threat posed to the environment by harmful chemicals increasing or decreasing? Due to the extremely large number of chemicals and variety of adverse effects, it is challenging to develop indicators for the success of our management of chemical emissions. Indicators for efficiency of chemicals management can be based on a) information on production, trade and use of chemicals, b) emissions, c) concentrations in humans and the environment and c) human and wild-life health, with data on the two latter being most relevant, but also difficult and/or expensive to produce for a wide range of chemicals. In this study, we used estimated consumption of products as point of departure to analyze time trends in use and emissions of chemical substances in the urban society and ultimately in the environment. Data on trade of manufactured products available in Eurostat was combined with chemical composition of products and materials compiled in the Commodity Guide hosted by the Swedish Chemicals Agency. The total mass of manufactured products in the northern Europe decreased slightly between 2003 and 2014. Despite this decline, ca 680 substances with significantly positive time trends due to increasing consumption of many products in which they are likely to be present were identified. We conclude, however, that substantially more data on chemical content of products is needed to successfully use consumption of products as a proxy for changes in chemical flows.

333 High-throughput assessment of use-phase exposures to chemicals in building materials

L. Huang, University of Michigan / Dept of Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; O. Jolliet, University of Michigan

Building materials have important contribution to the chemical exposure of the US population. The NHANES data have shown that the blood levels of brominated flame retardants and phthalate plasticizers, tend to be higher in children. The present study thus aims to develop a high-throughput method to determine exposures to chemicals in building materials, which mainly happen during the use phase but are often not considered in traditional LCA. The assessment framework calculates the product intake fraction metric, PIF, to assess consumer exposures during product use, i.e. the fraction of a chemical in a product that is cumulatively taken in by the users. Based on the building materials Phaoros database, 22 product categories for building materials and 218 chemicals were identified. We focus here on 632 unique chemical-product combinations, and assess doses based on PHAROS chemical content data. Chemical emissions from building materials are on 632 unique chemical categories for building materials and 218 chemicals were identified.

Drivers of pharmaceutical exposure in urban river systems

E. E. Burns, University of York / Chemistry; L. Carter, University of York / Environment Department; J. Thomas-Oates, University of York / Chemistry Department; A. Boxall, University of York / Environment Department

Pharmaceuticals are heavily used by society and urban environments are one of the main receptors for these molecules. Pharmaceuticals can be released from WWTPs and TPPh respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liagkouridis et al. (2017) for bulk emissions to indoor air. These “bottom up” emissions from indoors to outdoors estimated here were one to two orders of magnitude lower than the “top down” estimations, which could be caused by higher emissions from commercial buildings. Pharmaceuticals are excreted from animals and humans and limited in the indoor environment. It is clear that elevated indoor and outdoor air concentrations of OPEs are due to emissions from the many products and materials to which they are added. When aggregated over a city scale, indoor air emissions vented to outdoor air were lower, but within one to two orders of magnitude of aggregate air emissions back calculated from urban concentrations. Indoor air concentration is governed by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoors, fate is governed by air advection and water movement, because of the high solubility of OPEs.

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Drivers of pharmaceutical exposure in urban river systems

E. E. Burns, University of York / Chemistry; L. Carter, University of York / Environment Department; J. Thomas-Oates, University of York / Chemistry Department; A. Boxall, University of York / Environment Department

Pharmaceuticals are heavily used by society and urban environments are one of the main receptors for these molecules. Pharmaceuticals can be released from WWTPs and TPPh respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liagkouridis et al. (2017) for bulk emissions to indoor air. These “bottom up” emissions from indoors to outdoors estimated here were one to two orders of magnitude lower than the “top down” estimations, which could be caused by higher emissions from commercial buildings. Pharmaceuticals are excreted from animals and humans and limited in the indoor environment. It is clear that elevated indoor and outdoor air concentrations of OPEs are due to emissions from the many products and materials to which they are added. When aggregated over a city scale, indoor air emissions vented to outdoor air were lower, but within one to two orders of magnitude of aggregate air emissions back calculated from urban concentrations. Indoor air concentration is governed by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoors, fate is governed by air advection and water movement, because of the high solubility of OPEs.
and High Technology; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; A. Di Guardo, University of Insubria / Department of Science and High Technology

Different monitoring campaigns showed higher PCB concentrations in the air of cities compared to rural areas, indicating the presence of ongoing emission sources in urban locations. This is the result of both the past usage of these chemicals in building materials and electrical equipment from which they can volatilize and/or migrate onto the surrounding areas, as e-waste is disposed of.

It was estimated that cities could emit up to about 1 tons/year of PCBs (Gasic et al., 2009; Diamond et al., 2010), which can be transported to rural sites, posing adverse effects to human and ecosystems. The city of Brescia, is characterized by the presence of a factory (Caffaro s.p.a.) that produced PCBs between 1930-1984 and its surrounding areas were found to be heavily contaminated with high PCB concentrations in soil at mg/kg levels. For this reason, about 200 ha of this city were declared National Priority Site for remediation (Sin Brescia Caffaro) by the Italian authorities, representing an important secondary source of PCBs to the atmosphere.

The aim of the present study was to investigate the potential of the Brescia city in driving the PCB contamination at regional scale up to 100 km from the point source and the current effects on air concentrations, combining measured data and a multimedia mass balance model. Different sampling campaigns were organized to collect samples of soil and leaves along four 100 km transects that ran in NW, NE, SW and SE directions considering the production plant as starting point. In each sample, the following PCB congeners were determined: PCB 28, PCB 52, PCB 101, PCB 153, PCB 138, PCB 180 and PCB 209. The results were analysed to understand the relative contribution of different PCB emissions routes to PCBs concentration with distance from the point source. Furthermore, a spatially resolved version of a dynamic air-vegetation-soil model (SoilPlusVeg model) was used to predict a temporal emission profile from the city.

2) verify if an emission source strength previously predicted for this city justifies soil concentrations in the surrounding area and, 3) evaluate the importance of other sources and processes involved in the contamination of local soils. This study shows how a combined modelling approach could be used to unravel the past and recent impact of PCB emissions from a source on the surrounding areas at a regional scale.

337 Using a Dynamic, Aggregate Exposure Model to Identify Far- and Near-Field Contributions to Human PCB Exposure through Time

L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; F. Wania, University of Toronto at Scarborough / Physical and Environmental Processes Group

Humans are exposed to polychlorinated biphenyls (PCBs) through "far-field" sources from the ingestion of contaminated food from aquatic and terrestrial environments and "near-field" sources from building materials in indoor environments. Earlier models that consider far-field exposure only tend to underestimate historical body burdens. In this presentation, we will explore the time-dependence of the relative contribution of far-field and near-field routes to aggregate human exposure to PCBs, to explain the discrepancy between previous far-field only model predictions and observations. We develop a mechanistic model that incorporates dynamic substance flow analysis, indoor-urban-rural fate modeling, and bioaccumulation and human toxicokinetic modeling, enabling a dynamic and mechanistic description of the complicated continuum from annual industrially processed amount of PCBs to the human uptake rate. The model is applied to simulate the time-variant exposure of Swedish women to PCB-28 and PCB-153 from 1930 to 2030. In terms of a female's lifetime longitudinal exposure, our modeling indicates that route-specific contributions to aggregate human exposure change with age and differ among birth cohorts: Near-field exposures are notable during childhood and teenage years, as well as for female cohorts born earlier, when the indoor environment was more highly contaminated. In terms of the exposure of individuals of different ages at the same time (i.e., the cross-sectional age-exposure relationship), the dominance of far- or near-field routes differs little among ages, but is largely dependent on the time a cross section is "sampled": Near-field routes dominate in the past (e.g., the year 1956) whereas far-field sources become predominant more recently (e.g., 1986 and 2016). This finding suggests that the dearth of PCB biomonitoring studies before 1990s has also contributed to the general belief that far-field sources dominate human PCB exposure. It further implies that there may also be a similar shift from a near-field dominance to a far-field dominance among a wide range of currently-used indoor chemicals, such as flame retardants. This work improves our understanding of the exposure dynamics, which would be beneficial for future pertinent management actions for exposure reduction and prevention.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (III)

338 Modelling of the environmental release of macro- and microplastics for seven different polymers

D. Weniger, Empa Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, EMPA

Microplastic exposure is a burning topic in environmental research, but few large scale exposure studies have yet been performed in freshwaters. Assessing the emissions of plastic is possible using a life-cycle oriented approach, and permits to compare the flow magnitudes for different sources. With our ongoing study, we aim at providing large scale predictions of macroplastic and microplastic exposure in European rivers and in the Great Lakes. The environmental flows of seven different commodity thermoplastics are estimated based on societal data. The polymers are chosen for their popularity of use and the frequency at which they are reported in the environment: low-density polyethylene (LDPE), high-density polyethylene, polypropylene (PP), polystyrene (PS), expanded polystyrene (EPS), polyvinyl chloride (PVC) and polyethylene terephthalate (PET).

The probabilistic aspect of the PMFA framework permits one to account for the various uncertainty sources and give a quantitative estimate of the final confidence in the results. In a first step, the anthropogenic life cycle of these seven polymers is modelled, from production to end of life of a total of 35 product categories. Various trade flows are included, as well as the life cycle of textile applications. This enables us to present an accurate estimation of the European and Swiss productions and consumptions. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-sensitivity pathways between the anthroposphere and the environment are described, and the resulting environmental flows are compared. Modelling the emission pathways between prime release and final discharge allows to pin-point the principal plastic pollution sources and the possibilities for pollution mitigation.

339 Modelling Microplastics in Rivers in the US

A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; C.M. Holmes, Waterborne Environmental Pollutants; R. Cross, University of Toronto at Scarborough / Department of Environmental Sciences; G. Raspa, Sapienza University of Rome / Department of Environmental Sciences; B. Nowack, EMPA

Pollution with nanoparticles- and microplastics (MPs; particles < 5 mm) is a topic of emerging concern and as such receives growing interest. Although measurement and monitoring data are indispensable, there also is a need for estimated concentrations to enable prospective assessments and to guide analysis of retrospective ecological analyses. Besseling et al. (2017) provided the NanoDUFLOW model, a detailed MP aggradation-transportation model integrated in a hydrological and particle transport model. A much larger scale model potentially suitable to simulate MPs originating from WWTPs is the iSTREEM model, which has been developed to estimate chemical concentration distributions for all rivers and streams of the USA receiving WWTP discharges. Here we merge these two riverine modeling worlds: NanoDUFLOW with iSTREEM for MPs, to simulate the full range of MPs from WWTP point sources in US watersheds and to assess export to the Great Lakes for a range of particle sizes. This combines the mechanistic realism of NanoDUFLOW, accounting for formation and settling of hetroaggregates, with the US well-established iSTREEM implementation. We modeled floating as well as non-float MP, for diverse sizes, from 100 nm to 10 mm, a range that incorporates the theoretical parabolic size-setting relationship reported by Besseling et al. (2017). Depth-dependent in-stream first order removal rate constants simulated with NanoDUFLOW were combined with standard iSTREEM output (which was used to simulate the emission, transport and water column concentrations of MP) in an Excel-based post-processing phase, without modifying the iSTREEM model directly. Simulations were spatially explicit with MP concentrations being modeled for the Sandusky River watershed in Ohio (~1000 km²). Emission rates from WWTP point sources were calculated for each of the 20 WWTPs within the watershed. Modelling results show the effects of population density, MP size and density on riverine concentrations and export to Lake Erie. Buoyant as well as the smallest non-buoyant MP fractions can be transported over long distances, reaching receiving waters such as the Great Lakes. In contrast, larger non-buoyant MPs settle more locally in the vicinity of the WWTPs. Simulating depth-dependent removal as demonstrated here could be incorporated into the core iSTREEM code in order to efficiently process all US waterways impacted by WWTPs, as well as examining ultimate marine discharge proportions by particle size. 

340 The routes to uptake and bioaccumulation of nanoplastics in freshwater sediments

R. Cross, C. Liddle, University of Exeter; T.S. Galloway, University of Exeter / Biosciences

Plastic contamination of freshwater sediments is well documented, and whilst quantitative measurement of these routes in sediments are emerging, assessing their potential uptake and transfer through food chains can contribute towards the data required to inform decisions as to the suitability of classifying nanoplastics as POPs. This study provides initial insights to address this question in...
an ecologically relevant system, using the freshwater aquatic worm *Lumbriculus variegatus*, representing an entry point for nanoparticles from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluorescently dyed nano-polystyrene (50 nm) upon their uptake is systematically examined using a combination of techniques including a novel fluorescence assay and fluorescence microscopy. A series of exposure scenarios are used to test the efficacy of different routes of uptake into the worm. Associations of nanoparticles to the worm’s surface are examined in waterborne exposures, whilst dietary uptake is tested using nanoparticles associated with an algae food source. The accumulation of nanoparticles directly from contaminated sediments is also investigated, alongside the fate of these particles in sediments to assess the relationship between nanoplastic mobility and accumulation. Results indicate that pristine nanoparticles and those contaminated with pesticides are both well internalised by the worms and that dietary uptake of a nanoplastic associated algal food source, with carboxylated and amended plastics experiencing greater uptake than non-functionalised particles. Sediments on the other hand, reduced the availability of these particles for uptake into the worms, potentially though strong associations of the nanoparticles to solid constituents of the sediment. Ongoing work addresses the potential for formation of an “ecocorona” to alter the bioaccessibility of nanoparticles for the worms. These results will also be presented during the platform presentation.

341 Life-history and biochemical responses of *Chironomus riparius* exposed to different sized microplastics

C. Silva, CESAM & University of Aveiro; I. Pestana, CESAM & University of Aveiro / Biology; C. Gravato, Faculty of Sciences, University of Lisbon / department of Biology & CESAM

Freshwater basins are an integral part of microplastics life-cycle, being a repository of plastic micro-debris. In fact, the levels found so far are similar to those found in marine environment and shoreline regions. The deposition and persistence of plastic micro-debris in sediments (lakeshores and riverbanks) makes them long-time available for benthic species. The objective of this study was to investigate developmental, and physiological effects induced by the presence of polyethylene microparticles (PE) in *Chironomus riparius*, due to its key-role in the freshwater ecosystem. For that partial life cycle tests using different sized polyethylene particles (PE 40-48 µm; PE 125 µm and PE 350 µm) allowed evaluation of effects on C. riparius larval growth and emergence patterns while acute exposures were used to assess effects in parameters related to neurotransmission (ACHE; antioxidant defences and biotransformation (CAT, GST total glutathione levels); oxidative damage (LPO); cellular energy allocation (CEA) and immune response (phenofozilases). Exposure to PE 40-48 µm caused deleterious effects at lower concentrations in comparison with larger particles in several parameters: larval growth and development time of both male and female imagoes and on emergence rate. PE 40-48 µm were then selected to assess effects on physiological homeostasis. Acute exposures to PE 40-48 µm generated alterations in C. riparius larvae antioxidant and biotransformation enzymes activities (CAT, GST and total glutathione) and activation of immune response (induction of phenoloxidases). Larvae exposed to microplastics showed also a depletion in energy reserves. Our study highlights the potential deleterious effect of microplastics for aquatic invertebrate populations. Results will be discussed in terms of effects of different sized plastic particles on different levels of biological organization within freshwater invertebrates and on the needed and ongoing research aiming to address the long term and indirect effects of these particles for natural populations and ecosystem functioning.

342 The effects of rigid and flexible Polyvinyl chloride (PVC) microplastic particles on the transcriptome of *Daphnia magna*

B. Trotter, University of Bayreuth / Animal Ecology I; I. Šchrank, J. Dummert, A. Weig, C. Laforsch, University of Bayreuth

Microplastics are ubiquitous in aquatic ecosystems, posing as a threat to biota of all trophic levels, as they have the potential to leach out incorporated additives, such as plasticizers, to the surrounding medium. Yet the question arises, if possible effects on biota are based on the polymer type alone, or if incorporated additives are responsible for the observed effects, as the insight desorbed from the polymer matrix. With our transcriptome analysis, which was conducted via the use of a microarray, we showed that *Daphnia* reacts substantially different to the chronic (31 days) exposure to rigid PVC or flexible PVC (with diisononyl phthalate (DINP) as a plasticizer) with changes in gene expression. Rigid PVC caused a fivefold up-regulation in a total of 19 genes (15 up-regulated and 4 down-regulated) related to stress (e.g. heat shock proteins, metallothioneins) in comparison to the control. Flexible PVC exposure lead to a fivefold change of a total of 267 genes (238 up-regulated and 29 down-regulated) related to the GO terms of proteolysis, carbohydrate and chitin metabolism, Vitelline membrane formation, yet most genes were related to immune response. Our attained results imply that flexible PVC had a more severe effect that might be attributed to the levels of DINP (biomethylation and biofilm formation on these two different microplastic particles. Therefore our results highlight, for the first time that differences in additive composition (absence or presence of a plasticizer) can lead to substantial differences in effects on aquatic species.

When ecotoxicology meets trophic ecology

343 Poster spotlight: TU149, TU150, TU151

344 Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food chain

E.L. Fernandes, University of Koblenz Landau; M. Bursch, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences

Pollution is a major driver of ecosystem change resulting in alterations in food webs and/or foodweb constituents. Some pollutants such as reduced antibiotic insecticides are taken up by terrestrial plants and may enter aquatic systems with plant parts such as leaves that are an important energy source in stream food webs. Thereby, food web interactions across the aquatic-terrestrial boundary may be affected through alterations in food quality. Here we studied the effects of a systemic insecticide, the neonicotinoid imidacloprid, and their potential propagation in a brown food chain. The model food chain consisted of imidacloprid contaminated terrestrial leaves (alder, *Alnus glutinosa* Gaertn.), aquatic meromelanic invertebrate decomposers (*Protonemura* sp.) and predators (*Isoperla* sp.). Effects of imidacloprid on survival and growth of decomposers and its leaf processing were assessed in a microcosm setting. Therefore, decomposers fed on control or contaminated leaves for 3 days on the microcosms. Every 6 hours the number of dead individuals was recorded. Potential propagation of imidacloprid effects were assessed by transferring surviving decomposers to cages containing the predator. The cages were deployed in an unpolluted stream for 9 days after which predators’ growth was analysed. Imidacloprid concentrations increased within the contaminated microcosms over time. The presence of imidacloprid in the water was associated with lower survival of both decomposers and leaf decomposition. The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid leaches from plant material and may influence downstream food webs directly and indirectly.

345 Accounting for trophic relationships in fish bioconcentration models applied with emergent-pollutants risk-assessment tools

h. baxeve, Wageningen Environmental Research; D. Denner, Wageningen Environmental Research / Environmental Footprint; S. Faust, Wageningen Environmental Consulting; J. van Gils, DELTARES; C. Lindum, Stockholm University / SEAC; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team

In the context of the SOLUTIONS EU FP7 project, we applied non-steady state bioconcentration models to predict concentrations of organic compounds in fish. A foodweb perspective was taken, accounting for uptake from water as well as from food, and accounting for different trophic relationships for several fish species used for human consumption. The foodweb bioconcentration model will be applied for a large number of emerging pollutants and a large number of locations (around 25,000 sub-catchments in the major European catchments). Water concentrations at these locations are obtained from chemical fate modelling using the STREAM-EU model. As a case study, results for 24 WFD priority substances are presented here. Predicted concentrations will be input to human health risk assessment. The model also provides insight in how trophic relationships together with species and compound characteristics determine bioconcentration and thus ecotoxicological risk. The core of the foodweb model is a bioconcentration model for neutral and ionisable organic compounds (Armont & Gobas 2004; Armitage et al. 2013) underlying each fish component. It calculates for given environmental conditions (pH and temperature) the uptake and elimination rates defining the one-compartment model of the internal concentration dynamics. The considered foodweb contains fish components with different trophic relationships, representing fish species used for human consumption with different body size and lipid content, chosen to represent extreme cases with respect to expected bioconcentration. Internal concentrations in phyto- and zooplankton are assumed to be in instantaneous equilibrium with water concentration. For 24 WFD priority substances concentration timeseries per sub-catchment from the STREAM-EU model were used as input to the foodweb bioconcentration model. Results were summarized in monthly and annual maximum and mean concentrations for all foodweb components in each sub-catchment and displayed in maps covering the
EU. From these results, e.g., median concentrations can be calculated per catchment or over allcatchments. Concentrations in fish depend on local exposure pattern and differ per subcatchment. They also depend on trophic position in a compound-specific way: any of the three fish components can be worst-case. To indicate risk to human health, concentrations need to be related to standards of e.g., acceptable daily intake.

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Model-based explorations of the variability in lake trout BAFs caused by physiology and trophic relationships

S. Baskaran, University of Toronto - Scarborough / Chemistry; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; F. Wurts, University of Toronto at Scarborough / Physical and Environmental Sciences

Because dietary uptake of fish is often a major vector of human exposure to persistent organic pollutants (POPs), much effort is directed towards a quantitative understanding of fish bioaccumulation with the help of mechanistic models. Such models require the input of the growth, feeding and respiration rates of a fish. However, often little consideration is given to the interdependence of these physiological parameters. Here, we calculate the bioaccumulation factor (BAF) of hypothetical POPs, with log $K_{ow}$ values ranging from 4.5 to 8.5, in lake trout (Salvelinus namaycush), with a food web bioaccumulation model that uses bioenergetic equations to ensure that the physiological parameters applied to a species are internally consistent (i.e. energetically balanced). Empirical growth rates and diets for lake trout in six Canadian lakes (Lake Slave Lake, Lake Ontario, Source Lake, Happy Isle Lake, Lake Opeongo, and Lake Memphremagog) are used to determine feeding rates. Respiration rates were derived based on the routine metabolic rates and the population specific activity coefficients (multipliers). When comparing differently sized lake trout within a lake, larger fish tend to have the highest BAF, because they allocate less energy towards growth than smaller fish and have higher activity levels. When comparing fish from different lakes, diet composition and prey energy density become important in determining BAF in addition to activity and the amount of total energy allocated to growth. Specifically, fast growing Lake Ontario lake trout, feeding on slow growing alewife, have higher BAFs; while slower growing small lake trout in Happy Isle and Source Lakes have low BAFs because they feed on invertebrates, which are low in the food chain. Moreover, very large trout in Great Slave Lake with higher energy requirements feeding on an energy rich diet have lower BAFs compared to the same sized trout in Lake Memphremagog feeding on less lipid rich rainbow smelt.

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Influence of an agriculture-associated toxicity gradient on a riparian predator-prey relationship in Romania

N. Graf, P. Dittrich, University of Koblenz Landau; M.H. Entling, University of Koblenz-Landau / Institute for Environmental Sciences; K. Frisch, M. Link, V.C. Schreiner, E. Ţîcoci, University of Koblenz Landau; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences

Riparian landscapes are key targets for the expansion of resort development and transportation. The chemical gradient in these areas is often associated with the use of herbicides, fertilizers, and pesticides in agriculture. In some countries these compounds are released from multiple sources into the ambient environment and are known to negatively impact endocrine and physiological functions within exposed wildlife. Protocols to assess bioaccumulation of these persistent chemicals within terrestrial systems are far less developed compared to aquatic systems. Presently, regulatory agencies in Canada, the USA, and the EU use only bioaccumulation information for fish to assess the bioaccumulation potential of POPs. However, it is also known that some chemicals that are not bioaccumulative in aquatic food-webs do biomagnify in terrestrial food-webs. To better understand the bioaccumulation behaviour of chemicals in terrestrial food-webs, we aim to produce a food-web model to assess the biomagnification of POPs in an apex avian predator, the Cooper’s hawk. Over 100 samples were collected from various trophic levels of the food-web including hawk eggs, songbirds, invertebrates, and berries. All samples were analyzed for a number of contaminants listed as priorities for monitoring by the Chemical Management Plan of the Canadian federal government. Stable isotope analysis of $\delta^{13}$C and $\delta^{15}$N signatures of hawks, songbirds, invertebrates, and berries was used to estimate the trophic position of each organism. Censored regression by maximum likelihood estimation was used to assess the relationship between the natural logarithm of each POP lipid equivalent concentration and trophic position. Trophic magnification factors (TMFs) were determined as the antilog of the regression slope. TMFs of PCBs, PBDEs, and OCPs ranged from 1.64 to 26.31, 2.87 to 14.88, and 0.61 to 38.40, respectively. Indicating that most legacy POPs are biomagnifying in this terrestrial food-web, TMFs of PFCs ranged from 11.8 to 29.3.

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Migration effects on pollutants in eggs of Arctic-breeding gese

D.J. Hitchcock, University of Oslo; M.J. Loonen, University of Groningen / Arctic Center; N.A. Warner, NILU - Norwegian Institute for Air Research / Environmental Chemistry; D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; I.M. Tombre, NINA - Norwegian Institute for Nature Research; P. Shimmings, BirdLife Norway; L.R. Griffin, WWT Caerlaverock Wetland Centre; Varpe, University Centre in Svalbard; T. Andersen, University of Oslo / Department of Biosciences; K. Borga, Department of Biosciences; University of Oslo / Department of Zoology

Arctic breeding barnacle geese (Branta leucopsis) are a herbivorous species that migrate from the United Kingdom to the Arctic every summer to breed. Females utilise resources towards reproduction along the flyway, including distant resources (United Kingdom and Northern Norway) and local resources (Svalbard) relative to the breeding grounds. Depending on migration route, allocation of resources towards egg production may differ within a breeding goose population. Thus different energy sources may also affect how pollutants are taken up and deposited to eggs, including those which are both protein and lipid soluble. In order to examine the effect of migration on pollutants in eggs, a field study was carried out during the breeding season of 2016. Eggs (N = 60) were collected at an island breeding colony in Svalbard and several hundred grams of vegetation (N = 15 samples) were collected at different sites along the gosse_s flyway. Resightings of ringed geese also took place in Northern Norway. Egg and vegetation samples were analysed for stable isotope of carbon ($\delta^{13}$C) and nitrogen ($\delta^{15}$N), as well as pollutants including protein-associated poly- and perfluoroalkyl substances (PFASs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be explained by PCBs and emerged to POPs like perfluorinated compounds due to overlapping signal, but stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across eggs. The same was true for PCBs. Protein associated pollutants (PFAS) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

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Trophic Magnification of Persistent Organic Pollutants Within A Terrestrial Food-Web Of An Avian Top Predator, the Cooper’s Hawk (Accipiter Cooperii)

K. Naot, SFU / Department of Biological Sciences; J.E. Elliott, Environment Canada / Science Technology Branch; F. Gobas, Simon Fraser University / Resource & Environmental Management; K. Drouillard, Great Lakes Institute for Environmental Research University of Windsor; D. Green, Simon Fraser University

Several types of legacy persistent organic pollutants (POPs), such as PCBs and DDEs, but not for PCBs. Protein associated pollutants (PFAS) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.
Toxicokinetic-toxicodynamic models as new tools for environmental risk assessment

S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; V. Baudrot, Université Lyon 1; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team

Today, the Environmental Risk Assessment (ERA) for chemicals is based on fitting standard dose-response (DR) models to quantitative data. Such data are usually collected from standard toxicity tests, from which the concentration leading to 50% lethality or effect (LC$_{50}$ or EC$_{50}$) is usually estimated at the end of the exposure. In this form of evaluation, the fact that endpoints are monitored over time is not fully exploited. Standard DR models do also assume that the exposure concentration remains constant during the experiment, what makes it difficult to extrapolate the results to more realistic exposure situations, for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxicodynamics (TKTD) models is suggested, because TKTD models describe the effects of a substance by integrating the dynamics of exposure [1]. Indeed, TKTD models have many advantages in terms of mechanistic understanding of the chemical mode of action, of deriving time-independent parameters, of interpreting time-varying exposure and of making predictions for untested and time-variable exposure. Another advantage of TKTD models for ERA is that they make it possible to calculate any LC/EC$_{50}$ for arbitrary effect strength x and any given exposure duration t. Nevertheless, being based on differential equations their mathematical complexity makes it necessary to numerically integrate the equations when fitting the model to data, so that in practice TKTD models are still rarely used.

351 Lethal and sublethal impacts of neonicotinoids and copper nano-particles on the energy budgets of an estuarine amphipod

E.B. Muller, University of California, Santa Barbara / Marine Science Institute; J. Couture, H.S. Lenihan, University of California Santa Barbara / Bren School of Environmental Science and Management; J. Means, University of California Santa Barbara; K. Tran, C. Vignardi, University of California Santa Barbara / Bren School of Environmental Science and Management; C. Pelosi, INRA, AgroParisTech; A. Péry, INRA, Ecological and Evolutionary Biology

Estuaries are major recipients of run-off pesticides from agricultural and urban origin, including neonicotinoids and nano-based copper formulations. Neonicotinoids have rapidly become the most widely used insecticides globally, and have been implicated for harming pollinators and non-target species at levels below existing US EPA toxicity thresholds. With most research conducted on insects, it is not yet clear if and at what concentration levels these substances have an effect on aquatic organisms. Advantages of nano-based copper formulations over ionic forms include better application control and slower release of copper, but the size and shape of nano formulation change the environmental behavior and toxicity profile of copper. The aim of this research is to assess the impact of those modern pesticides, in particular CuPRO, Kocide and imidacloprid, on an estuarine non-target species (Leptochirus duodecurrens). Estuaries are based on dynamic energy budgets. This approach, due to its process oriented structure, toxicity assessment statistics are independent of exposure time and of choice of sublethal endpoints. Copper speciation was rapid, with little change observed in dissolved and aggregated copper after 1 day. The copper accumulation profile did not depend on the form in which copper was administered, but increased with dose. The impact of copper on respiration showed a regular dose-response pattern with little difference amongst copper formulations; the no-effect body burden and the body burden at which the respiration rate doubled was estimated from pooled data at 149 and 303 µg Cu/g DW, respectively. Similarly, survival declined in a normal dose-response manner with no difference among formulations. The no-effect body burden estimated at 188 and 291 µg Cu/g DW. Sublethal impacts were more pronounced than lethal ones, especially before day 7, indicating that cannibalism has an mitigating impact on the decline of the total amount of biomass in the container. We conclude that the toxicity profiles of nano-copper and ionic copper are similar for this amphipod, which indicates that this species, being a detritus feeder, readily ingests nanoparticles.

352 A biology-based model to analyze growth data of earthworms exposed to copper at different development stages

S. Bagt, A. Amosse, C. Mougin, A. Péry, INRA/IpAgri/Paristech; C. Pelosi, INRA (Institut National de la Recherche Agronomique)

Assessing effects of a contamination on populations requires getting data on the whole life cycle and accounting for differences in sensitivity throughout this life cycle. Copper contamination is one of the greatest concerns in agricultural soils, especially in vineyards. This contamination may have negative effects on soil fauna, such as earthworms, which are recognized as ecosystem engineers providing very valuable ecosystemic services. To assess effects of copper on earthworm populations, we tested the impact of a commercial formulation of copper fungicide, i.e., Cupra Micro® (50% copper oxychloride), on different endpoints, including growth, for the earthworm species Aporrectodea caliginosa, one of the dominant earthworm species in agricultural fields. We performed original tests assessing the impact of copper on the growth at 3 different development stages with many times of replication (R=100 individuals; new born juveniles (10-15 mg), juveniles (90-110 mg) and large juveniles (260-340 mg). To analyze simultaneously all the data, we developed and used a biology-based model. This model is based on the DEB (Dynamic Energy Budgets) theory. A DEB model was set up and validated under controlled conditions, using different food conditions. The growth data were then analyzed with a toxicokinetics-toxicodynamics model to account for differences in growth and differences between development stages) coupled with a DEB-based toxicodynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 66 mg kg$^{-1}$ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided understanding of the mechanisms of copper toxicity to earthworm growth throughout development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.

353 Connecting suborganismal and organismal responses using Dynamic Energy Budget Modeling and the ecological model species Fundulus heteroclitus exposed to dioxin-like chemicals

L.M. Stevenson, UCSC / Ecology, Evolution and Marine biology; E.B. Muller, University of California, Santa Barbara / Marine Science Institute; D.E. Nacci, B. Clark, U.S. EPA / Atlantic Ecology Division; A. Whitehead, University of California Davis / Environmental Toxicology; R.M. Nisbet, University of California Santa Barbara

Comprehensive and efficient management of ecological risk depends on our ability to quantitatively extraplate the effects of stressors across levels of biological organization. Adverse Outcome Pathways (AOPs) connect sub-organismal mechanistic molecular data to organismal outcomes, while bioenergetics models, such as Dynamic Energy Budget (DEB) can extrapolate from individual- to eco-level-effects of toxicant exposure. However, the connection between the two modeling frameworks remains a challenge. The molecular mechanisms underlying Key Event (KE) relationships defined in AOPs are often poorly known, even for well-studied compounds; thus, the mechanistic linkages between KEs and effects on DEB processes are often difficult to discern. Further, AOPs whose adverse outcome is lethality or reproductive failure can be hard to operationalize. Further, sublethal effects of DLCs are less studied, but preliminary data indicate that sublethal PCB1216 exposure leads to slower growth in larval killifish (Nacci unpublished data). Therefore, this system offers a framework to test our ability to connect AOP KEs to DEB processes through a model of damage dynamics. The model predicts regulated but increasing concentrations of damage as the result of toxicant exposure and also tipping points when damage outpaces regulatory feedbacks, leading to mortality (Kanjšcek et al. 2016). The connection between damage dynamics and DEB will be influenced by empirical and theoretical observations, but potential linkages include damage causing an increased maintenance cost or specific impacts on development. Specifically, we are studying the effect of DLCs on Fundulus heteroclitus (Atlantic killifish). DLCs are of particular interest in this species due to the large intraspecific variability in sensitivity. There is extensive data describing the toxic effects of DLCs through AOPs and DEB models in other species (e.g. the AHR pathway or the Leptochirus duodecurrens). Fundulus are based on dynamic energy budgets. With this approach, due to its process oriented structure, toxicity assessment statistics are independent of exposure time and of choice of sublethal endpoints. Copper speciation was rapid, with little change observed in dissolved and aggregated copper after 1 day. The copper accumulation profile did not depend on the form in which copper was administered, but increased with dose. The impact of copper on respiration showed a regular dose-response pattern with little difference amongst copper formulations; the no-effect body burden and the body burden at which the respiration rate doubled was estimated from pooled data at 149 and 303 µg Cu/g DW, respectively. Similarly, survival declined in a normal dose-response manner with no difference among formulations. The no-effect body burden estimated at 188 and 291 µg Cu/g DW. Sublethal impacts were more pronounced than lethal ones, especially before day 7, indicating that cannibalism has an mitigating impact on the decline of the total amount of biomass in the container. We conclude that the toxicity profiles of nano-copper and ionic copper are similar for this amphipod, which indicates that this species, being a detritus feeder, readily ingests nanoparticles.

354 Quantitative Adverse Outcome Pathway Modelling of Endocrine Active Toxicants in Rainbow Trout

L.R. Schultz, NOAA NWFS / Marine Science Laboratory; L. Harding, University of Washington / Aquatic and Fishery Sciences; C. Monson, University of Washington / School of Aquatic and Fishery Sciences; K. Gillies, Pacific NW. NWFSC, NOAA / Department of Biological Sciences; P. Swanson, NOAA/NWFS

We are investigating best approaches to utilizing in vitro derived toxicity data for estimating impacts on reproduction in trout and salmon. Our goal is to facilitate development of quantitative in vitro – in vivo extrapolation (IVIVE) methods to support adverse outcome pathway (AOP) based toxicity testing. We tested a diverse suite of toxicants using cellular assays based on the female rainbow trout pituitary, ovary and liver. Each assay measures an essential reproductive endocrine function (cytochrome P450 activation & transcriptomics) along with effects on underlying Key Event (KE) relationships defined in AOPs (e.g. aromatase, estrogens). A comprehensive understanding of the mechanisms of copper toxicity to earthworm growth throughout development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.
such as estrogen synthesis and secretion by ovarian follicles. In vitro results are extrapolated to metrics of reproductive performance (fecundity, fertility, egg size) in trout using a mathematical model of the trout hypothalamic-pituitary-ovary-liver (HPOL) axis. We evaluated IVIVE by comparing predicted effects against laboratory results obtained from a yearlong exposure of female trout to four different chemicals: tamoxifen (biotransformed into the anti-estrogen 4-OH-tamoxifen), prochloraz (interferes with ovocyte maturation), fluoxetine (SSRI pharmaceutical largely negated in our in vitro assays) and trenbolone (potent synthetic androgen). A single water exposure level was tested for each chemical, guided by preliminary studies and a desire to use a maximum tolerated exposure that still allowed spawning to occur. Laboratory exposures began 10 d after the first spawning cycle and lasted until time of ovulation and completion of the second spawning cycle (12-14 months later). Trout were euthanized and total fecundity determined along with egg mass and diameter, fertility, hatching success and larval growth. Results indicated no effect on fecundity was observed except after the 60 ng/L trenbolone exposure, which caused regression of ovary growth and a failure to spawn in all exposed fish. Fluoxetine had no effect on reproduction. The most significant effects on egg quality occurred after the 500 ng/L tamoxifen (30% decrease in egg mass and diameter) and 20,000 ng/L, prochloraz (increase in atretic / non-fertile eggs) exposures. The tamoxifen induced decrease in egg size translated to significantly smaller larvae at 20 dph. The HPOL model, guided by in vitro testing, accurately predicted the reproductive effects of prochloraz and tamoxifen and the lack of effect by fluoxetine. Our results support the use of biologically based mathematical models of physiological systems in AOP testing. Supported by EPA-STAR grant R835167.

355 Development of a PBPK model for metal accumulation in fish infected with anacanthocephalan parasites

Y. T. Le, University of Duisburg-Essen / Aquatic Ecology; M. Garcia, Spanish Council for Scientific Research; M. Nachev, D. Grabner, University of Duisburg-Essen / Aquatic Ecology; E. Balsa-Canto, Spanish Council for Scientific Research; J. Hendriks, Radboud University Nijmegen; B. Sures, University of Duisburg-Essen / Aquatic Ecology

Fish are affected by both exposure to metals and infection. Each of these stressors might have effects on the response of fish to the other. Some efforts have recently been made in developing kinetic models for predicting metal accumulation in fish-parasite systems. Our previous model allows for investigating the relationship between the accumulation in the whole fish and in the anacanthophalan, but does not include the mechanisms how metals are accumulated in parasites.

Physiologically based pharmacokinetic (PBPK) model has been used for simulating the non-specific accumulation of pollutants. However, the capacity of this model for simulating fish-parasite systems has not been investigated. We developed a PBPK model for simulating Ag accumulation in the host-parasite system: chub (Squalius cephalus) and the anacanthophalan Pomphorhynchos tereticolis. The anacanthophalan was considered a compartment, similar to blood, storage, gills, kidney, liver, and intestine. Metal accumulation in the system was modelled as a function of internal (i.e. exchange between different compartments) and external (i.e. exchange with water) factors. The transport from blood to other compartments depends on the diffusive exchange and the fraction of metals dissolved in blood plasma and was assumed to be independent of the infection state. The rate constants for this transport were parameterised based on published data. The model was then calibrated by MATLAB-based AMIGO modelling software for determining the rate of thi Seiport from storage, gills, kidney, liver, and intestine to blood as well as the external exchange. Model calibration was carried out by using experimental data generated when the infected chub were exposed to Ag in 48-day exposure and 51-day depuration periods. The initial results from model calibration show potential of the PBPK model for simulating the accumulation of metals in fish-parasite systems.

For example, the model could simulate the changes in the concentration of Ag in storage, gills, and intestine. The stability in the concentration of Ag in kidney was also simulated by the model. However, the model is being further calibrated to improve its capacity for modelling the accumulation in liver and in the anacanthophalan. The observed weakness of the current version in modelling the accumulation of Ag in these compartments might be related to the approaches for simulating the excretion of organo-metal complexes to intestine.

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (III)

356 High-throughput exposure and risk modelling of chemicals in European river basins

J. van Gils, DELTARES; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; h. baveco, Wageningen Environmental Research; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); C. Lindén, Stockholm University; S.S. Kutsarova, University of Zlatarov / Laboratory of Mathematical Chemistry; S.D. Dimitrov, University of Zlatarov / Dept of Comp Inform Technologies

SOLUTIONS is a EU 7th Framework Programme R&D project that aims at strengthening the management of emerging contaminants. It developed a collection of integrated models (the "Model Train"), to increase our understanding of issues related to emerging chemicals in Europe’s river basins, to support the prioritisation of chemicals and the abatement of the problems they cause and to evaluate future scenarios. The model train consists of four key building blocks: (i) the prediction of substance properties based on their molecular structure, (ii) the simulation of emissions, (iii) the simulation of fate & transport, and (iv) the characterisation of the risk of mixtures of chemicals for human health and aquatic ecosystems. The Model Train does not rely on extensive substance-specific input data. This implies that the predicted effects are truly "emerging" chemicals and for large numbers of chemicals ("real world exposure scenario"). The approach is validated for well-studied substances and data-rich basins. On this basis we learn how accurately our model based predictions are for new substances and data poor basins.

The model train operates on the scale of Europe as a whole or for one or more individual river basins. It makes use of the pre-existing Europe-wide hydrology model E-Hype. The Model Train complements lab and field based approaches, by providing information for substances and sites which are not included in monitoring and by providing full time coverage. Validation results for the Danube, Rhine, four Spanish and a series of Swedish River Basins reveal that the accuracy of the simulated concentrations of a range of chemicals is higher for substances with a single type of use (e.g. pharmaceuticals, pesticides) and lower for substances with multiple uses. The predicted chemical and ecological monitoring results, lend by a correlation with the observed ecological status as EU Member States report it under the Water Framework Directive. The SOLUTIONS Model Train will offer an effective tool to screen a large number of chemicals on their impact on Europe’s aquatic ecosystems, and to do so with consideration for spatial and temporal gradients as governed by socio-economic and meteorological/hydrological patterns in combination with the chemicals’ physical and toxicological properties. The presentation will include the validation results and will highlight some of the Model Train application results from SOLUTIONS.

357 Forward-looking on possible impacts of chemical pollution: Modelling lethal and sublethal effects of chemical exposure on population viability for aquatic macroinvertebrates

A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); J. van Gils, DELTARES; S. Birk, University of Duisburg-Essen / Aquatic Ecology; e. Peeters, Wageningen University / Aquatic Ecology and Water Quality; P. van den Brink, Alterra Wageningen University; h. baveco, Wageningen Environmental Research

One challenge in the quality assessment of water bodies in Europe is the ongoing difficulty to link the chemical and the ecological status. Currently, new approaches are being envisaged to align chemical and ecological monitoring results, hence providing the means to elucidate possible chemical impact on the ecological status of European water bodies in a retrospective way. Ecological modelling provides an alternative approach to access exposure information to potential impact on biota, having the advantage that such modelling can be performed in a prospective way. This presentation will show results of ongoing modelling efforts in the EU 7th Framework Program SOLutiOns (SOLUTIONS) project. The main approaches are applied to link exposure dynamics of a number of chemical compounds to parsimonious individual-based population models. The STREAM-EU model provides exposure concentration results at the level of subcatchments, that is at a scale of tens of km². Links between exposure and effects are realised using linear or log-logistic dose-response relationships. The ecological models account for lethal and sublethal effects on the population dynamics of a number of families of aquatic macroinvertebrates. Impacts of multiple chemicals are added up in the model following basic mixture modelling rules. Results depict the simulated inhibition of population growth rates and hence the chemical impact on population viability at European scales. Ecological modelling results are for some selected pairs of Europe compared with available monitoring information on the abundances of macroinvertebrate families in order to get an impression about the quality of the model predictions.

358 Eco-epidemiology of aquatic ecosystems: aligning chemical and ecological status

L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; S. Birk, University of Duisburg-Essen / Aquatic Ecology; A. Burton, University of Michigan / School of Natural Resources Environment; D. De Zwart, DAZ Ecotex / Centre for Sustainability Environment and Health; S.D. Yder, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C.M. Holmes, K.E. Kopo, Waterborne Environmental, Inc.; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; J. van Gils, DELTARES; M.C. Zijp, RIVM / Centre for...
Sustainability Environment and Health

This paper analyses water quality assessment and management specifically looking at the diagnosis of toxic effects of mixtures in field ecosystems. We apply various methods to liaise ecosystem responses to mixture toxic pressure under natural, variable and multi-stressed conditions. We collated vast amounts of monitoring data to explore those diagnostically, in line with the Father of Epidemiology, dr. S. Birk, whom famously provided a solution to a cholera outbreak. (Soho, London 1854, by epidemiological reasoning. So, this paper presents a set of contemporary eco-epidemiological results, the recognition of ecological impacts in surface water systems, and the diagnosis of probable causes. The paper presents the utility of that for chemical- and water quality assessment and management, thereby bridging preventive policies such as REACH via e.g., a Mixture Assessment Factor and environmental management policies such as EU’s Water Framework Directive. We present novel results of scientific research at the nexus of chemical and water policies, connected to the European goals to reach a non-toxic environment and the good chemical and ecological status for aquatic systems. The presentation consists of the analyses of vast sets of surveillance monitoring data using a combination of techniques originating from the fields of bioassessment and ecotoxicology. It thereby bridges these - so far often disparate - scientific disciplines, to support sustainable chemical and water policies. One of the most recent examples is provided by a diagnostic analysis in which the Good Ecological Status appeared associated to the Good Chemical Status, the latter shown to be a limiting factor for reaching a good ecological status. The presentation will provide a rationale for eco-epidemiological analyses as well as various types of results, from diagnostics to prognosis states and strategies. The future EU project MARS (Mixing Aquatic stressor responses in ecosystems and water resources under multi Stress) recently concluded four years of in-depth research on this topic. MARS looked into multi-stressor responses from experimental water body to pan-European scale, developed tools for modeling and diagnosing multi-stressor effects and guided management of multiple stressed aquatic ecosystems. Our presentation summarizes the key conclusions of the project, with a special emphasis on pan-European multi-stressor effects on the ecological status, including river hydrology, morphology, nutrient and toxic stressors.

360 Mitigation options for chemicals of emerging concern in surface waters: operationalizing solutions-focused risk assessment

A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Fischer, Utrecht University / Copernicus Institute of Sustainable Development; J. van der Hoek, Technical University Delft / Water Management Institute / Environment Canada; R. Schaefer, University Koblenz Landau / Institute e.V. / Sustainable Products & Material Flows Division; K. Sakmann, OIKO Institute

Future developments in society will result in the emission of new substances to the environment which will require an adaptation of existing legislation for protection of human health and ecosystems. Scenarios for the future development of society can provide valuable indications on changes in future pollutants in river basins. Some developments are directly connected to consumption of specific substances, e.g. demographic change where a longer life expectancy will lead to changes in amounts and types of pharmaceuticals used and thus also to the related concentrations in the environment. Future technological progress may help to identify and reduce alternatives. Users of chemicals are likely to adapt their use with respect to new knowledge on effectiveness, risks and environmental friendliness. This paper presents evaluation options for minimising risks as to quantifying risks for new substances under development or introduction; (2) Transparency and openness of information and knowledge. Current applied research aimed at providing solutions to identified problems of chemical contamination in e.g. water ecosystems is severely limited by a lack of information on the production and use of chemicals in society as well as on emissions to water. Linkage of national databases on use volumes of industrial chemicals such as SPIN (Substances in Preparations in Nordic Countries) would allow tracking quantitatively substitution of the most problematic substances; (3) Increased international cooperation and strengthened global agreements. The world is globalized and the transport of chemicals is transboundary – both via the atmosphere and via global trade.

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (I)

D. Bajard, Environment Canada; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences; C.B. Chung, Environment Canada/Canadian Rivers Institute / Department of Biology; A. Bush, Environment and Climate Change Canada; S. Bracewell, Wageningen University & Research / Department of Aquatic Ecology and Water Quality Management; A. Chariton, Macquarie University / Molecular Ecology and Toxicology; Z. Compton, Environment and
Climate Change Canada; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; L.E. Johnston, University of New South Wales / Evolution and Ecology Research Centre; K. Korbel, Macquarie University; D. Lapen, University of New South Wales; M. Mayer-Pinto, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; W. Monk, Environment and Climate Change Canada; A. O'Briain, University of New Brunswick; N. Rothenberg, Environment and Climate Change Canada; K. Simon, R. Vrdonischez, Wageningen University; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra

In the Anthropocene, ecosystems are exposed to a range of stressors that if not properly managed can lead to ecosystem state shifts and significant losses in ecosystem services. We held a workshop (September 2017, Wageningen, The Netherlands) to develop a conceptual framework to assess the effects of multiple stressors on the structure and functioning of aquatic ecosystems. This framework was subsequently applied to three ecosystem types (ditches, floodplains and harbours). The proposed framework consists of two parts: an environmental filter and a transmitting function to allow effects to propagate to higher levels of biological organisation. Applying the framework consists of the following steps: (1) Select an ecosystem of concern; (2) Identify stressors and potential interactions; (3) Identify receptors/sensitive groups for each stressor; (4) Identify stressor-response relationships and group stressors according to their mode of action; (5) Construct an ecological model that includes relevant functional groups and endpoints; (6) Predict the resultant impact of multiple stressors; (7) Confront the predictions with experimental and monitoring data; (8) Adjust the ecological model if needed.

Steps 7 and 8 can be repeated until a satisfactory match between model predictions and experimental and monitoring data has been obtained. The talk will present the details of the framework and will also briefly introduce the three case studies developed during the workshop and discuss the commonalities and differences in approaches between the three case studies which all used the framework as a starting point.

363 Predicting the response of ditch ecosystems to multiple stressors S. Bracewell, Wageningen University & Research / Department of Aquatic Ecology and Water Quality Management; R. Verdonschot, Wageningen University & Research (Alterra); R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences; A. Bush, University of New Brunswick / Environment and Climate Change Canada; D. Lapen, Agriculture and Agri-Food Canada; K. Sumon, Wageningen University & Research Centre / Aquatic Ecology and Water Quality Management; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra

Until recently, our knowledge of the net effects of multiple stressors on freshwater ecosystems has been limited. We still lack a general framework that can integrate known effects of individual stressors on organisms and predict how these effects propagate through higher levels of biological organisation. In light of this, a workshop was held at Wageningen University and Research, the Netherlands, (September 2017) to determine the current state of knowledge of multiple stressor effects on aquatic ecosystems and to assess how these effects can be better predicted. The workshop was attended by experts from the Netherlands, Australia, Germany, and Canada and covered a range of ecosystem types considered to be at high risk from multiple stressors. The workshop resulted in a “best-approach” conceptual framework for assessing multiple stressor effects on aquatic ecosystems. The framework was subsequently applied to three case studies: harbours, agricultural drainage ditches, and floodplains. Here, we present the application of this framework to agricultural drainage ditches. Agricultural drainage ditches are an under-appreciated and undervalued habitat for a range of aquatic and terrestrial organisms. Although these man-made features can maintain high biodiversity in agricultural landscapes, they are often ignored for their conservation value and are not protected under the EC Water Framework Directive 2000/60/EC. Using the framework developed during the Wageningen workshop, we developed a conceptual food-web model using functional groups to assess known direct effects of stressors on ditch communities. We identified the most important stressors (nutrients, pesticides, dredging and mowing, salinisation, and sediment) impacting ditch communities and conducted a literature search for each stressor-functional group combination to identify sensitive and non-sensitive groups. We also reviewed the literature on experiments using at least two of the identified stressors and identified potential interactions. The conceptual food-web model was updated using this knowledge to capture interactions. Finally, the conceptual model and its predictions regarding the response to multiple stressors will be compared to large scale ditch biomonitoring data to assess the validity/predictive power of the model. The demonstration of this framework provides a useful conceptual template to assess and predict multiple stressor impacts as well as to unravel research gaps.
different mode of action (the chemical pesticide Chlorpyrifos, CPF, and the biopesticide Bti) in the mosquito Culex pipiens. We expected that the effects of the single exposures are strengthened in the presence of DTV. In addition, we tested whether there is an interaction between CPF and Bti and whether this interaction is magnified in the presence of DTV. We crossed three DTV treatments (no DTV, a small DTV of 7°C and a large DTV of 14°C) with four pesticide treatments (a solvent control, single CPF exposure, single Bti exposure and exposure to the CPF-Bti mixture). We measured effects on 1) larval growth and population growth rate (r’) and 2) mortality. The experiment was done in three steps: i) 4-day exposure in L4 to DTV, ii) 2-day exposure to DTV and the pesticide treatment and iii) exposure to DTV until metamorphosis. The presence of a large DTV increased the toxicity (based on r’) of the chemical pesticide, but not the biopesticide. Moreover, a large DTV changed the ratio of the CPF-Bti mixture. For example, the presence of large DTV removed the antagonistic interaction effect on total mortality which was present in the absence of DTV and in the presence of small DTV. Our results underscore the importance of considering DTV as a factor shaping not only the toxicity of pesticides but also the interaction type between pesticides in mixtures. Given DTV occurs in all natural populations and may strongly differ between latitudes, DTV may be an important factor causing a mismatch between toxicity studies done in the lab at constant temperatures and the toxicity of pesticides and their mixture in the real world.

367 Wresting and daily temperature fluctuations make the pesticide chlorpyrifos more toxic in Ischnura elegans damselflies
J. Verheyen, R. van Roo, KU Leuven / Biology; R. Stoks, University of Leuven / Department of Biology
Current risk assessment of pesticides fails to protect aquatic biodiversity. A key reason is the lack of realism: pesticides are tested under ideal laboratory conditions at one mean temperature. To strengthen current risk assessment it is crucial to incorporate effects of global warming on the toxicity of pesticides. Global warming studies largely overlook that climate scenarios also predict stronger daily temperature fluctuations (DTFs), which can have greater fitness effects for organisms than increases in mean temperatures. While many pesticides (like organophosphates) get more toxic at higher temperatures, it is largely unknown how DTFs influence the pesticide toxicity. We examined a multiple-factor scenario where we quantified the single and combined effects of (i) increases in mean temperature and (ii) in DTF, and (iii) exposure to the pesticide chlorpyrifos (CPF) in larvae of high- and low-latitude populations of Ischnura elegans damselflies. CPF imposed mortality and more so in high-latitude compared to low-latitude larvae. Moreover, CPF was more toxic at 24°C compared to 20°C, confirming the higher toxicity of organophosphates at higher temperatures. A key finding was that DTF also increased the toxicity of CPF, providing novel evidence that DTFs can amplify the toxicity of pesticides. Furthermore, the increased toxicity of CPF by DTF was more pronounced at 24°C. This novel pattern is likely general as at a higher mean temperature, DTF will expose the animals to even higher temperatures during the daily cycle, thereby increasing exposure to stressful temperatures. Also, the negative effect of CPF on larval growth strongly depended on DTF. CPF did decrease larval growth considerably, but only in the 10°C DTF treatment. Probably the higher metabolic demands for cell maintenance in the 10°C DTF treatment resulted in lower growth rates. Our results convincingly show that the organophosphate pesticide chlorpyrifos is not only more toxic to damselfly larvae at the higher mean temperature (24°C) but also at higher daily temperature fluctuations (DTFs). The behavioral plant effects presented in this study allow evaluating at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation by ozone and chlorine. Highly polar PMOCs such as adamant-1-amine (Log D = -2.34), trifluoromethanesulfonate (Log P = -1.35) and caprolactam (Log P = 0.15) were not removed by PAC even for very high doses. Only naphthalenesulfonate (Log P = -0.41) was fully removed for 5 mg L⁻¹ PAC. The other PMOCs i.e. aromatic sulfonates, aromatic sulfinates, phenols, were removed significantly for high PAC doses, but that are not compatible with drinking water production. Most of the PMOCs identified in water resources showed a very low reactivity with ozone with rate constants below 100 M⁻¹ s⁻¹ and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-di-p-tolylguanidine and the 1,3-di-o-tolylguanidine, an olefinic sulfonate and an amine compound, the N-benzylidemethylene, were rapidly transformed by ozone. Transformation of both guanidines occurred in few seconds at neutral pH during disinfection by chlorine. Chlorinated and hydroxylated analogues, and products of cleavage and cyclization were identified. US EPA toxicity prediction tool showed that chlorinated and hydroxylated analogues and O-methylated and N-oxidized analogues of PMOCs were more toxic than the parent compound, which was confirmed by Microtox acute toxicity test for Cl₃guanidine ratio of 1 and 10. Thus, reactions with chlorine during disinfection can be a source of new, persistent and more toxic chemicals in drinking water Some PMOCs like caprolactam, halogenated methane sulfonates, adamant-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor degraded by activated carbon. Furthermore, oxidation processes and could thus be present in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.

370 Removal of polar micropolutants from drinking water by reverse osmosis: a pilot scale study
V. Albergamo, University of Amsterdam/IBED Institute / IBED; E. Cornelissen, KWR Watercycle Research Institute; B. Blankert, Oasen, W. Knibie, University of Wageningen; W. Van der Meer, Oasen & University of Twente; P. de Voogt, University of Amsterdam / IBED
The occurrence of polar micropolutants (MPs) in drinking water sources is regarded as one of the most challenging issue of our times. Polar MPs can preferentially remain in the water phase during environmental and water treatment processes, potentially reaching finished drinking water and thus raising concern over adverse effects to human health. In The Netherlands reverse osmosis (RO) has been proposed as a stand-alone treatment capable of producing impeccable drinking water. As riverbank filtration is a future-proof water treatment method, the removal of MPs identified in water resources is crucial in retaining organic compounds depending on physicochemical properties such as size, charge and polarity. The aim of this study was to assess whether riverbank filtration followed by RO can provide sufficient removal of MPs and thus be considered for further implementation. We also aimed to elucidate the transport of organic solutes through RO membranes by relating solute physicochemical properties to solute passage. A novel pilot-scale RO system capable of operating in aerobic conditions was built for this study. Raw aerobic riverbank filtrate was used as feed water. The feed was spiked with 30 target polar MPs selected from scientific literature and considered relevant for the quality of source waters and critical for drinking water.
RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultrahigh-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPs displayed less than 5% passage, except benzotriazole, toluyltrazole and phenylurea, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that removal of neutral polar MPs is mainly governed by size exclusion. For neutral and moderate polar MPs the inverse was true. In some cases the passage was well over 90%, as seen for bisphenol A, which displayed 4% passage. The higher passage of moderately polar and hydrophobic MPs could be attributed to solute-membrane hydrophobic interactions followed by diffusion. All anionic MPs displayed less than 1% passage, opposed to cations for which up to 10% passage was observed. The negative charge of the membrane surface is strong enough to retard cations. Overall this study showed that high chemical removal rates can be achieved by RO. Tighter membranes and multi-stage RO will be investigated to improve the removal of small neutral MPs for drinking water applications.

371 Identification of transformation-derived very polar organic water contaminants and their relevance in the water cycle
D. Zahn, Hochschule Fresenius / Chemistry and Biology; P. Mucha, V. Zilles, Hochschule Fresenius, University of Applied Sciences; A. Touffet, H. Gallard, IC2MP UMR 7285 CNRS - University of Poitiers; T.P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology; T. Frömel, Hochschule Fresenius, University of Applied Sciences

Highly polar organic substances are well water soluble, non-volatile, and exhibit only minimal adsorption to nonpolar surfaces. Therefore, they may be able to penetrate natural and artificial barriers and are thus mobile in the water cycle. If these mobile organic contaminants (MOCs) are persistent (PMOCs) against microbiological and chemical degradation, their removal during wastewater treatment and drinking water purification may prove difficult. Toxics PMOCs can be classified as PMT (persistent, mobile, and toxic) substances. Since the most frequently used trace analytical method for the quantification of organic pollutants in aqueous matrices, reversed-phase high performance liquid chromatography - tandem mass spectrometry (RP-HPLC-MS/MS), is only of limited use for the analysis of very polar substances, little is known about PMOCs in the water cycle and only few (e.g. acsulfame, glyphosate) have been extensively studied and monitored.2, PMOC may be, among others, industrial chemicals, or transformation products thereof. Most transformation processes usually result in the formation of transformation products (TPs) with increasing polarity until either mineralization is achieved or a dead end TP is formed, thus potentially resulting in persistent and highly polar wastewater products. Many PMOCs derived from transformation processes may still be unknown and thus not be represented in suspect or target screening campaigns. As a consequence, no information about their occurrence and origin is available, which severely exacerbates the sophisticated monitoring and effective regulation of their precursors. Based on the work of Arp et al.3 and Schultze et al.4 we selected 15 industrial chemicals with a high expected potential to form PMOCs and studied their behaviour during hydrolysis, biotransformation, oxidation with MnO2, and photoysis experiments. After structural elucidation of the 9 detected transformation products with high resolution mass spectrometry (HRMS) we developed a qualitative HILIC-MS/MS (Hydrophilic interaction liquid chromatography – MS/MS) method and screened 25 Hessian water samples for the presence of these TPs. While some TPs were not detected, others were detected by the major transformation and screening data provides first information about the potential environmental relevance of the identified TPs, which can be used to prioritize them for inclusion in future quantitative screening campaigns.

372 The limited chemical application domain of regulations: An illustration using the POP screening assessment in the Stockholm Convention
M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES)

Regulatory frameworks are initiated by a societal concern and built upon the scientific knowledge existing at the time they are written. This imparts them with a validity domain, as the implications of the assessment frameworks can be applied in the context for which they were conceived and supported by a sound scientific foundation. As time passes, societal concerns change, and this can lead us to want to apply regulatory frameworks outside of their chemical application domain. Today we have the ambition to regulate tens of thousands of chemicals, the regulatory frameworks that were in some cases developed 20 years ago with a more modest level of ambition and less scientific knowledge than we have today. Are these regulations really up to the task? This question is explored using the example of the POP screening assessment in the Stockholm Convention. Using perfluorinolated alkyl acids (PFAs) and octamethylcycloptetrasiloxane (D4) as case studies, it is shown how this framework can lead to both false negative and false positive conclusions. False negative classification of PFAAs can arise because of the inclusion of bioaccumulation as a screening criterion in the framework although bioaccumulation is not a requirement for adverse effects of chemicals in remote regions. False positive classification of D4 can arise because the four screening criteria (persistence, bioaccumulation, long-range transport, and adverse effects) are not valid in the same environmental media/compartment. It is concluded that if we wish to conduct POP assessment for the broad spectrum of chemicals in modern commerce, then we will have to rely less on individual screening criteria and instead apply models that can capture and integrate the broad diversity of chemical behaviour.

373 'One for all and all for one' - Can we REACH a harmonised PBT-assessment across EU-regulatory frameworks?
C. Rauert, Umweltbundesamt / International Chemicals Management; A. Bohlhardt, German Environment Agency; J. Priegnitz, Umweltbundesamt / FG IV 1.3 - Pflanzenschutzmittel; A. Wiemann, UBA Umweltbundesamt; J. Schmidt, German Environment Agency

Persistent, bioaccumulative and toxic (PBT) substances and REACH are frequently called in one breath. However, also other European regulatory frameworks for chemicals, such as for biocides, plant protection products (PPP), veterinary and human medicinal products (VMP/HMP) stipulate the performance of a PBT-assessment during substance evaluation. As in other hazard based assessments (e.g. GHS/CLP regulation, POP), the PBT/vPvB assessment focuses on the properties of a substance only and does neither take into account the use of the substance nor its exposure. Consequently, the identification of a PBT or vPvB substance should be independent from the regulatory framework under which it is assessed. However, in our comparison of conclusions on PBT properties for a number of substances falling under more than one legislation it became apparent that the outcome of the PBT assessment does not necessarily correspond between different regulations. This stands in contrast to the goals to perform a comprehensible and consistent assessment of chemicals and to ensure a high level of protection of human health and the environment against hazardous chemicals within the EU. In order to elucidate the reasons still hampering a harmonised PBT-assessment, we did a compilation of a number of technical (amount and quality of data, acceptability of specific data, derivation of endpoints, applied guidance documents), and conceptual criteria (numerical criteria, testing strategy, assessment of transformation products) as well as of other factors (consequences of PBT-assessment, data management and publication of assessment results). Outgoing from this, we developed several proposals facilitating a harmonised PBT assessment, starting from the implementation of an overall PBT-guidance up to an inclusion of transformation products in the PBT-assessment by all regulatory frameworks. Although it cannot be denied that a harmonisation process is ongoing, we conclude that there are still some fundamental choices to be made both at the organisational level and at policy level first to achieve the goal of a standardised PBT-identification among all legislations.

Product benefits and positive outcomes: valuation and beyond

374 A need for a better characterisation of product benefit in life cycle sustainability assessment
T. Schaubroeck, Luxembourg Institute of Science and Technology (LIST) / Research Group EnVOC; E. Benetto, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation

In life cycle assessment (LCA) the main focus is on damage assessments of production systems. These damages are conventionally characterized per so called functional unit. In practice, however, these functional units are partially descriptive, e.g. white light from a point source with 1500 lumen, and not well assessed. In the first part of this study we therefore further elaborate the functional unit towards product benefit. When taking a closer look at the concept of functional unit, it is imperative to define what functionality implies. Products have been created to fulfill human needs, e.g. the need for light at night provided by a light bulb. Through fulfilment of needs, human well-being is induced. The characterisation of the actual functionality hence boils down to the assessment of this well-being effect. In consequential LCA, not only the consequences related to the needed activities associated with the product life cycle should after all be considered, but also those associated with the benefit induced by the product. In the second part, we specify how a better product benefit characterisation could improve life cycle assessment and its policy support. Three advantages are specified. First, as these functional units are often not specifically defined and a product can have multiple functions, comparison is often impeded in practice. Second, for a respective product, the functional unit is not necessarily the same. A better specification of the functional unit in terms of an aggregated single score for product benefit, such as the net impact on human well-being, would permit to compare all types of products. Third, not only would a better characterisation of the product benefit allow for a better comparison of various production systems, it also allows one to compare the benefit of the product with the damage provided during its production. One can then develop a holistic sustainability system that is not only constrained to not having it. When an additional amount of byproduct is created by a production system, this may also induce a byproduct benefit, which can be
Results demonstrate that substantial reductions can be attained in GHG emissions through the optimization of diets in Peru. For instance, in Lima the reduction could reach 200 kg CO2eq per person and year (22%). These results constitute an important framework to understand the current situation of the GHG emissions of the average Peruvian diet, as well as to mitigate these emissions while improving nutritional aspects and controlling economic costs.

375 Assessing nutritional impacts and benefits on human health in LCA: A new midpoint impact category

K. Stylianou, University of Michigan - School of Public Health / Environmental Health Sciences; V.L. Fulgoni III, Nutrition Impact, LLC; O. Jollivet, University of Michigan

Defining a crucial determinant of human health. According to the Global Burden of Disease (GBD), dietary risk factors are responsible for >10 million deaths/year globally. Yet, beneficial and detrimental nutritional health effects, the dominant pathway for health in food systems and diets, are often neglected in Life Cycle Assessment (LCA). To address this, we develop 14 nutritional characterization factors (CFs) for food groups and nutrients using epidemiological evidence from the GBD, and propose a new nutritional midpoint impact category for LCA, demonstrating its application to the entire US diet. We develop marginal nutritional CFs for 8 major food groups (nuts and seeds, whole grains, fruits, vegetables, milk, sugar-sweetened beverages, red meat, and processed meat) and 6 nutrients (omega-3, calcium, polyunsaturated fats, trans fats, and soda), identified by the GBD as dietary risk factors. CFs are estimated by coupling age- and gender-adjusted information on outcome-specific incidence rates with risk ratios (RR) and severity factors, measuring positive or detrimental effects in avoided μDALY/y. We also develop a profiling system for 6000+ food items consumed in the US that aligns publically available data from multiple databases with risk factor definitions from the GBD. Finally, for 6000+ food items we estimate the HEalth Nutritional Index (HENI), the total avoided health burden from all dietary risk factors per serving and 100 kcal. Nutritional CFs for food group and nutrient range between -8 avoided μDALY/y for soda, up to 57 avoided μDALY/y for omega-3 from seafood. HENI score typically ranges from -80 avoided μDALY/serving for Frankfurter sandwiches to 50 avoided μDALY/serving of nuts and seeds. Absolute HENI scores and ranking of food items vary substantially when using 1 serving or 100 kcal as a functional unit. Unhealthy food groups such as mixes, dishes, and protein foods with the exception of seafood and nuts and seeds have negative HENI scores primarily due to detrimental effects from processed and red meat, saturated and trans fats, and soda. Healthy food groups such as fruits, grains, and vegetables excluding starchy vegetables tend to have positive HENI scores dominated by health benefits from their respective food groups. The estimated nutritional CFs for a new midpoint impact category in LCA that would improve human health impact assessment in LCA and allow for a comprehensive assessment of food items and diets.

376 Combining Operational Research and Life Cycle Assessment to optimize the environmental performance of Peruvian diets

J. Vázquez-Rowe, Pontifical Catholic University of Peru / Civil Engineering Environmental Science; G. Larrea-Gallegos, Pontificia Universidad Catolica del Peru / Civil Engineering Environmental Science; A. Gilarino, Pontificia Universidad Catolica del Peru / Industrial Engineering

Food production and security has been highlighted as one of the most threatened sectors worldwide due to the consequences of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, 10% of household expenditure is destined to food purchase. In contrast, malnourishment is still rampant in many socioeconomic sectors, mainly in the Highlunds in the Amazon basin. In this context, it appears as a major challenge to jointly achieve nutritional improvements in the Peruvian diet and reductions in terms of GHG emissions. Hence, the main objective of this study was to apply a methodology which allowed optimizing the environmental profile of the Peruvian diet while improving its nutritional requirements at competitive economic costs. In other words, the aim of the optimization model was to determine an optimal diet from an environmental perspective considering nutritional and economic constraints. For this joint combination of Operational Research and Life Cycle Assessment was performed. Based on the average diets identified for each city included in the study, an optimization was performed considering a set of criteria that respond to the three dimensions of sustainability. Nutritional aspects were included in the model through a restriction based on the minimum consumption of food types and caloric intake recommended by Peruvian authorities. Regarding economic constraints, the model included a set of inequations that limited the minimum and maximum monetary changes throughout the year (i.e., 2016). Finally, environmental aspects were considered by introducing an objective function that minimizes the emissions of CO2eq of the entire food basket. The result of the proposed linear program allows understanding the amount of each individual food product that should be consumed in each city that satisfy all the restrictions included in the model in order to attain the lowest GHG emissions possible. AMPL® was used as the programming platform, and CPLEX® as the solver. Results demonstrated that substantial reductions can be attained in GHG emissions through the optimization of diets in Peru. For instance, in Lima the reduction could reach 200 kg CO2eq per person and year (22%). These results constitute an important framework to understand the current situation of the GHG emissions of the average Peruvian diet, as well as to mitigate these emissions while improving nutritional aspects and controlling economic costs.

377 Using the first Swiss dietary survey to determine the environmental and health benefits and impacts of various dietary patterns

A. Ernstoff, Quantis / Quantitative Sustainability Assessment; S. Humbert, X. Bengoa, M. Vargas Gonzalez, Quantis; O. Jollivet, University of Michigan

Many studies compare the environmental impacts of dietary patterns such as dietary recommendations (e.g. food pyramids), vegetarian and vegan diets. Mounting evidence suggests diets high in red meat and other animal products have higher associated environmental impacts. A hypothetical non-meat diet is often considered in such assessments, which may e.g. be equi-calorie or mass to the meat containing diet. In this study we use the first Swiss National Survey (MenuCH) to determine what non-meat eaters consume in Switzerland and what potential environmental and health benefits (or impacts) may result from assessing realistic consumption. About 5% of the Swiss population self-identifies as vegetarian, and less than 1% as vegan. Meatless diets contained about the same overall mass of food consumed, generally offered environmental and health benefits through increased fruit and vegetable consumption, but vegan diets can be insufficient in certain essential vitamins if not supplemented. Nuts, seeds, and their oils were important sources of key nutrients such as vitamin E. In conclusion, using dietary surveys can help provide us with evidence as to what people eat. Our study looks into the monetary value other animal products from the diet. Accounting for the environmental and health benefits of realistic dietary patterns, can help support improved recommendations.

378 The cost of CO2 in Life Cycle Assessment

Y. Dong, Technical University of Denmark; R. Rousselet, Ecole Centrale de Marseille / Engineering School; H.J. Sørensen, Technical University of Denmark / DTU Environment; P. Pantke, Technical University of Denmark / Quantitative Sustainability Assessment Division; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering Division / Quantitative Sustainability Assesment

Climate change has gained increasing attention over the past decade in response to the revelation that we need to maintain a viable climate for humans and the environment. The increasing emission of greenhouse gases (GHG) such as CO2 may accelerate climate change and cause subsequent damages. Correspondingly, countries and companies actively develop strategies to minimize their GHG emissions and thus climate impacts, but which strategies that will be more beneficial is often hard to evaluate. Life Cycle Assessment (LCA) is a tool to evaluate the damages of GHG emissions from the whole life cycle of the intended strategies, taking a cradle-to-grave perspective. By monetising the impacts related to these emissions, they can be compared to the overall cost of a strategy. This secure that emissions are considered in determining the priority and benefits of the reduction vectors for GHG emissions. Our study looks into the monetary values of GHG, represented by CO2 (or CO2-equivalent), and their underlying cause-effect chains in three Life Cycle Impact Assessment (LCIA) methods LIME2, EP2015 and ReCiPe2016. The damage cost for CO2 is in the same order of magnitude in EP2015 and ReCiPe2016, but one order of magnitude higher than that in LIME2. Climate change-related damages on human health are well represented in all LCIA methods, and the monetised damages from this category contribute to more than 70% of the total CO2 cost in all three methods. Social assets and ecosystem damages, on the other hand, are only counted for in two of them. Furthermore, a range of potential socio-economic damages from a changing climate are discussed in IPCC reports, including economic loss from extreme weather events, costs of potential climate-related society security and poverty, but they are not included in any of the LCIA methods. This may limited the suitable application area of the CO2 cost evaluated by LCA, especially in studies where social and economic consequences are the major concerns. The CO2 costs from the three LCIA methods are further evaluated in comparison with approaches from other research fields, such as Social Cost of Carbon (SCC), and discrepancies and associated uncertainties are discussed.

379 Poster spotlight: WE257, WE258, WE259

Advances in monitoring and evaluating remedy effectiveness for in situ amendments in soils and sediments

J. Kvasnicka, University of Michigan, Ann Arbor USA / Environmental Health Sciences; K. Stylianou, University of Michigan - School of Public Health /
Environmental Health Sciences; G. Burton, University of Michigan / School for Environment and Sustainability; J. Semrau, University of Michigan - Civil and Environmental Engineering and Program in the Environment; O. Jolliet, University of Michigan

Billions of dollars have been spent on environmental dredging projects to remediate contaminated sediments. However, the extent to which this remedy can reduce human health risks is unclear. Environmental dredging projects can also create health impacts from resuspension of sediment, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents. 4) Compare the avoided health impacts, i.e., the health benefits, with the created health impacts. For each considered impact pathway, we derived both central and upper bound estimates, using the disability adjusted life year (DALY) as a comparative metric. For the No Action scenario, the health impacts are 11 and 78 DALYs per kg AC, depending on the assumptions made. In the DPM and NOx scenario, the health impact is 0.97 DALYs per kg AC. When exposure is limited to DPM and NOx emissions, the health impact is 0.04 DALYs per kg AC. The results indicate that an AC cap can be considered a cost-effective strategy for treating contaminated sediments. In addition, the use of AC can provide a long-term solution to remediation, as the AC cap can significantly reduce the potential for resuspension of sediment and air emissions of harmful pollutants. Overall, the use of AC as a remediation strategy for contaminated sediments is a viable and cost-effective solution. 383

Possibility of using a genotoxic tests in planning precise phytoremediation of depleted soils enriched in organic amendments

A.O. Murtas, Czestochowa University of Technology / Department of Infrastructure and Environment; M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering; A. Grobelak, Czestochowa University of Technology / Department of Infrastructure and Engineering

A natural soil at many sites becomes toxic due to upstream industrial activities. Increasingly, human industrial activity, our irresponsibility, and impunity have a negative influence on the condition of soils. Thus, the problem of soil contamination, especially with several nanoparticles, and multiple heavy metals refers mainly to the industrial areas. Majority of those contaminations are bioavailable, and they are deposited in plant tissue as well as in edaphon. Moreover, they can migrate through soil to groundwater or phytoremediation systems. The toxic influence of heavy metals and nanoparticles can result in a decrease of soil bioavailability and impact on the quality of soil. Plant-based remediation techniques can be used to mitigate the effects of soil contamination. Several studies have shown that plants can be effective in the remediation of contaminated soils. The use of phytoremediation can be further enhanced by the use of nanoparticles, which can be added to the soil to increase the bioavailability of heavy metals. The use of nanoparticles in phytoremediation can be an effective strategy for the remediation of contaminated soils. Overall, the use of nanoparticles in phytoremediation can be an effective strategy for the remediation of contaminated soils. However, the potential risks associated with the use of nanoparticles in phytoremediation need to be thoroughly investigated. 384

Sorption of pharmaceuticals in soil systems

L. De Cesari, Environmental Department University of York / Environment Department

Pharmaceuticals are widely used in human and animal health and are found in the environment, often in the form of wastewater effluents. These compounds can have adverse effects on human and animal health, as well as on the environment. Therefore, it is important to understand the fate and behavior of pharmaceuticals in soil systems. The sorption of pharmaceuticals in soil systems is influenced by a range of factors, including soil properties, organic matter content, and the nature of the pharmaceuticals. The sorption of pharmaceuticals in soil systems can be studied using various methods, including isotherm studies, batch experiments, and column studies. The results of these studies can be used to predict the behavior of pharmaceuticals in soil systems and to develop strategies for their remediation. Overall, the sorption of pharmaceuticals in soil systems is a complex process that is influenced by a range of factors. Understanding this process is crucial for the development of effective strategies for the remediation of contaminated soils.
been detected at fairly high levels in aquatic systems (0.33-611 ng/L), terrestrial environments (0.53-340 µg/kg), and in the tissue of organisms (4.6-23.6 µg/kg in crop tissues, 61-127 µg/kg in terrestrial invertebrates) (Chen and Ying, 2015; Kinney et al., 2006; Pan et al., 2014). Long-term exposure to the residues of pharmaceuticals could pose a risk to the ecological system and exert adverse effects on human health via food chain (Carvalho et al., 2014). Adsorption processes have a decisive role for the environmental behavior and the ultimate fate of pharmaceuticals (Drilli and Lyberatos, 2005). However, relatively a few investigations of the sorption of organic compounds at the group level based on the dissociation degree of molecule in soil have been published so far (Droge and Goss, 2013; Franco and Trupp, 2008; Franco et al., 2009; Kah and Brown, 2007). The main aim of this study was to explore the effects of properties of the chemical and soil parameters on the sorption of organic compounds in soil. First, sorption behaviors of nineteen pharmaceuticals across four groups ( neutrals, strong bases, weak bases, acids) were explored in five test soils. Using the measured sorption coefficients for each group, we evaluated the applicability and accuracy of existing predictive models that have been proposed to predict the sorption behavior of organic chemicals in soil. Finally, Pearson correlation analysis and Principal components analysis (PCA) have been carried out at the group level to systematically assess the potential factors (both soil and drug properties) influencing the sorption behavior of pharmaceuticals in soil and to get better understandings of the sorption mechanisms of different pharmaceuticals in the soil.

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In vitro and in vivo assays to evaluate chlordecone transfer to animals: interest of soil amendment

M. DELANNOY, URAPPA-INRA / URAPPA INRA; S. Gaspard, Université de Antilles / COVACHIM; A. Razafitianamaharo, LIEC Université de Lorraine CNRS; C. Cakir-Kiefer, Université de Lorraine / URAPPA INRA; C. Soligot, E. Montiargues-Pellietier, C. Fechter, G. Rychen, Université Lorraine UL / URAPPA INRA

Chlordecone (Kepone) (CLD) is a highly persistent pesticide formerly used in France and the Netherlands. Nowadays high levels of this pesticide are still found in soils which represent a serious source of contamination for outdoor-reared animals. In that context, questioning matrices as activated carbons (ACs) or biochars are believed to efficiently decrease CLD transfer to animals. The present study intends to test using 2 distinct in vitro tests prior an in vivo assay the respective efficiency of several biochars and ACs to limit CLD transfer to animals. The Te-PBET and the ISO/DIS 16 751 availability part A protocols were used. In each test amended soils were prepared from a control one (SS) by adding 2% (mass basis) of one of the ACs or biochar. A selection of interesting matrices was realized prior the in vivo part of the protocol. Results of both in vitro and in vivo tests showed that only treatment groups exposed through amended soil with ACs presented significant decreases CLD availability, bioaccessibility (< 8%). Similar results were found using both in vitro assays. At last, concentrations of CLD in piglet liver and adipose tissue were found significantly lower after exposition to an AC amended soil (p < 0.001). This decrease was particularly high for a coconut shell activated carbon where relative bioavailability was found lower than 3% for both tissues. Finally, a positive correlation was found between environmental availability, bioaccessibility tests and in vivo results. This study leads to conclude that (i) AC introduced in CLD contaminated soil should strongly reduce CLD availability; bioaccessibility and bioavailability (ii) Tested biochars showed no reduction of transfer (iii) availability and bioaccessibility tests could be useful screening tests in order to select the appropriate biochar or AC.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (I)

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Determination of dioxin-like polychlorinated biphenyls in land near the dumps of some settlements of the Republic of Armenia

A. Aleksandryan, Hazardous Substances & Waste Policy Division / Head of Division; A. Khachatryan, Y. Bunyatyan, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology in the Republic of Armenia

The sources of environmental pollution with polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN 169 was determined less frequent and at insignificant quantities. Attention was drawn to the following: - out of 7 randomly selected soil sampling sites, a 2 to 3.5 times exceeding of the total/summary standard level was found at four sites; - in all cases, the excess of the standard was due to PCBs NN 81 and 114. Of special attention is the fact that at one of the soil sampling sites (Dilijan Town, Tavush Province of Armenia) along with 3.5-fold exceeding the standard, almost all dioxin-like PCBs were found.

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Associated Health Effects of Veterinary Pharmaceutical Residues in Water Basins near Some Settlements of Armenia. The following 14 dioxin-like PCBs were determined in soil samples: congeners NN 77, 81, 105, 114, 118, and 123, while NN 169 was determined less frequent and at insignificant quantities. Attention was drawn to the following: - out of 7 randomly selected soil sampling sites, a 2 to 3.5 times exceeding of the total/summary standard level was found at four sites; - in all cases, the excess of the standard was due to PCBs NN 81 and 114. Of special attention is the fact that at one of the soil sampling sites (Dilijan Town, Tavush Province of Armenia) along with 3.5-fold exceeding the standard, almost all dioxin-like PCBs were found.

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Characterization of respective contribution of agriculture and urban sources to pesticide contamination of a peri-urban river

V. Dufou, EPOC - UMR 5805 CNRS / UMR 5805 - EPOC LPTC; C. Chollet, J. Cruz, University of Bordeaux / UMR 5805 - EPOC LPTC; D. Granger, M. Capdeville, M. Chambolle, L3RE - Centre de Recherche et Développement SUEZ; H. Budzinski, University of Lorraine  UL / URAFPA

Water is nowadays a precious resource on which anthropogenic pressure increased drastically these last years, due to global lifestyle improvement and the population growth. Pesticides are part of the most prevalent micropollutants in aquatic environments because of their intrinsic toxicity, even at trace-levels. They were firstly used for agricultural yield improvement but they are now used as biocides for the protection of construction materials, wood, textiles, paints, etc., or as veterinary treatment susceptible, and can be discharged in rivers via wastewater treatment plants (WWTP) or Separated Stormwater Overflow (SSO). This multiplicity of uses is linked to high concentrations in rivers, affecting aquatic ecosystems that play role of final receptacle for micropollutants in general. It is thus necessary to consider pesticide inputs to water resources. Treatment of pesticides can be quite expensive and inputs may not be clearly identified or collected. Hence, reduction at source can be considered as an interesting alternative (dose reduction, practice changes, etc.). However this approach requires first of all the identification of uses responsible for inputs, as few information is available nowadays. This study monitored for 4 years a peri-urban continuum formed by a river, SSO and a WWTP also as wastewater to link uses and presence in environment. Water bodies presented distinct contaminations profiles: rivers were characterized by important concentration of plant protection products while WWTP effluents presented important concentrations of biocides and veterinary molecules which are among the most toxic pesticides. Flux calculation allows identifying agriculture as the major source of plant protection products while WWTP brought the most part of biocides and veterinary products, especially in low flow period when the WWTP contribution is up to 40% to the overall flow of the studied river. Storm sewers had an intermediate status, with less consequents inputs but are still significant because of lack of treatment on these effluents and a potential increase of concentration around the
discharge site. Investigation in the wastewater network identified uses responsible for introduction of some molecules like fipronil or glyphosate which is essential in reducing targeted pollutants and determining the trigger pollutants.

389 Study of bioconcentration of benzophenone-3 in gill-head Bream and characterization of Phragmites australis
H. Ziarrusta, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; R. Montes, University of Santiago de Compostela; R. Rodil, University of Santiago de Compostela; J. Quintana, University of Santiago de Compostela; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; U. Izagirre, University of the Basque Country UPV/EHU/ CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; N. Etxebarria, M. Olaveiras, O. Zuloaga, University of the Basque Country UPV/EHU / Plant Systems Biology; M. Bárzana, University of the Basque Country UPV/EHU / CIBER de Bioengeñería; J. L. Hidalgo, University of the Basque Country UPV/EHU / Dep Analytical Chemistry

Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation, and owing to its hydrophobic properties, it could potentially bioaccumulate in aquatic biota, including fish (tens to thousands of ng/g). BP-3 can undergo both photodegradation or phase I and phase II metabolism, generating transformation products and metabolites.

Environmental risk assessment approaches often require information on the free concentration in water, bioaccumulation factors in aquatic organisms, by-products and their toxicity in order to determine the effect of a contaminant on ecosystems. Thus, in the present work, in order to assess the uptake, distribution in different tissues (liver, muscle and gill) and bio-fluids (plasma and bile), metabolism and elimination of BP-3 in gill-head Bream (Sparus aurata), a controlled dosing 14-day experiment was designed at 50 ng/mL concentration level. BP-3 was detected in all the analysed samples, with the highest concentrations at day 14. Bile concentrations were significantly lower in comparison to the rest of tissues/fluids. Since BP-3 is hydrophobic and non-ionizable compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipidic) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolism activity in liver. And on the contrary, the lack of biodegradation activity in muscle (less lipidic) can explain the second highest concentrations detected, reaching the equilibrium state in the 4th exposure day. In any case, the occurrence of BP-3 in gills suggests that at least part of the uptake occurred through the gills. To completely characterize BP-3 exposure, the analysis performed by means of liquid chromatography – high-resolution mass spectrometry allowed the identification of a broad suite of BP-3-by-products in seawater and fish tissues/biofluids (mainly in bile and liver). By the interpretation of the MS2 spectra, we identified demethylation, hydroxylation and glucuronidation as the main degradation pathways of BP-3. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the projects CTM2014-56628-C3-1-R and CTM2014-56628-C3-2-R, Xunta de Galicia (ED431C17/36) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

390 Phragmites australis enantioselectively uptake, translocate and degrade the chiral pesticides tebuconazole and imazalil
L. Mijangos, Nottinghame / School of Animal, Rural and Environmental Sciences; P. Carvalho, Aarhus University / Department of Environmental Science / Department of Environmental Science; M.E. Casas, Aarhus University / Department of Environmental Sciences; U.E. Bollmann, Aarhus University / Department of Environmental Science; C.A. Arias, H. Brix, Aarhus University / Department of Biosciences; K. K. Bester, Aarhus University / Department of Environmental Science

Phytoremediation is an emerging technology that utilizes green plants and their associated rhizosphere microorganisms to clean polluted environments. The role of plants in removing organic pollutants is still not well understood. Phytoremediation of realistic environmental concentration (10 ng/mL concentration lev) of the chiral pesticides tebuconazole and imazalil by a wetland plant, Phragmites australis, was investigated. The experiment was carried out in a growth chamber dark at 26 ºC for 5 days. Forty-six metabolites of imazalil in V. unguiculata were investigated using ultra-high performance liquid chromatography quadrupole time-of-flight mass spectrometry (UHPLC-QToF-MS). To this end, the developed method achieved simultaneous quantitative analysis of imazalil, 1 and 2-hydroxyimazalil and carboxyimazalil while preserving the instrument ability to get precursor and product ion mass spectra of non-target compounds. The trigger was the precursor ions to reach 100 cps intensity. Seeds of V. unguiculata were obtained from Guiz area of Saudi Arabia, were germinated in Petri plates or sown in indoor seed trays. After 3 days of germination, seedlings were transplanted to small pots containing soil, watered and exposed to a B. thaliana and 9 of them (conjugates of ibuprofen or naproxen) are, up to our knowledge, reported for the first time in plants.

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (I)

392 Environmental Risk Assessment of Active Pharmaceutical Ingredients used in Human Medicinal Products: Europe-wide Variation in Risk Quotient
S. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; S. Owen, AstraZeneca / Safety & Health Environment; C. Tyler, University of Exeter / School of Biosciences College of Life and Environmental Sciences; B. Verbruggen, University of Exeter; L. Gunnarsson, University of Exeter / Biosciences College of Life and Environmental Sciences

This presentation will describe the total consumption-based environmental risks posed by 130 human medicinal products and the impact of mode of action, lipophilicity and dilution on these risks. In accordance with Article 8(5) of Directive 2001/83/EC, as amended, a new marketing authorisation application shall be accompanied by the evaluation of the potential environmental risks posed by the human medicinal product. These environmental risk assessments (ERAs) estimate the potential environmental impact on a product-by-product basis rather than a substance-by-substance basis. In the cases where an active pharmaceutical ingredient (API), or substance, is used to treat multiple clinical diseases, there is the potential to under-estimate the impact of the drug by treating them as if each were used for a single indication. The European Medicines Agency (EMA) guidance for the environmental risk assessment of human medicinal products has been in place now for over 10 years. The introduction of this guidance marked a step change in the ERA requirements for human medicinal products, with a shift from short-term acute to long-term chronic environmental effects assessments, and tailored ERAs for active pharmaceutical ingredients (APIs) with suspected or known reproductive effects. To determine the total substance or API risk, we have: (i) identified and collected definitive published no observed effect concentrations (NOECs) for available APIs (excluding anti-infectives and anti-parasitic products); (ii) collated human consumption data for each of these APIs in European Countries where these products are licenced for use; (iii) conducted a worst case exposure assessment (predicted environmental concentration for each API (PEC) and predicted environmental concentration for each API (PECF)) and estimated the risk for each API across Europe and (v) looked at the impact of country-specific dilution factors applying the 5th percentile and
393 Estimation and prioritization of hospital API emissions
A.M. Ragas, Radboud University / Department of Environmental Science; C. van Laake, M. Galen, K. Tipatet, Radboud University; R. Oldenkamp, Radboud University / Meijer Institute of Environmental Chemistry; University Hospitals constitute an important source of APIs, particularly for substances like antineoplastics and contrast agents. Measuring these emissions and their impacts is possible, but is very time-consuming and costly. The main aim of the present study was to develop an approach for estimating hospital API emissions based on hospital purchase data and to prioritize these emissions based on potential environmental impact. A model was developed to estimate the API loads reaching the hospital sewer system. The model accounts for the return of unused APIs, route-specific excretion by patients, non-patient API use (e.g., personnel) and off-side emissions. The model was operationalized for 16 APIs emitted by two academic hospitals in the Netherlands. Model predictions were validated based on measurements of APIs in the sewer system using passive samplers with speediQ® as absorbent. The samplers were deployed over a 10-12 day period and analyzed in the laboratory using LCMS. Most of the estimated loads were within a factor of 10 of the measured loads. On average, estimations for Hospital 2 were more accurate than for Hospital 1, which was probably due to the use of monthly purchase data and some other small model improvements implemented for Hospital 2. APIs which are typical for hospitals (e.g., antineoplastics and contrast media) were relatively well predicted. The prioritization of the APIs based on environmental impact was substantially influenced by the availability and interpretation of toxicological data. Diclofenac ranked highest, but this ranking was determined by one particular toxicity study of which the validity is being disputed. Ciprofloxacin consistently ranked high, and to a lesser extent also paracetamol and metoprolol. Azithromycin and iomeprol also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

394 Development and validation of a model to predict concentrations of human APIs in European surface waters
R. Oldenkamp, S. Hoeks, V. Barbarossa, M. Cengic, Radboud University Nijmegen / Department of Environmental Science; L. Carter, University of York / Environment Department; E.E. Burns, University of York / Chemistry; J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department; A.M. Ragas, Radboud University / Department of Environmental Science; D. van den Berg, E. Papa, A. Sangion, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; P. Gramatica, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA)

Active Pharmaceutical Ingredients (APIs) are consumed in large quantities, and end up in the environment as a result of not being degraded completely during passage through the human body and wastewater treatment plants (WWTPs). Although reported concentrations are generally low, adverse ecological effects caused by some human APIs are plausible considering their specific modes of action and high potency. Consequently, the issue of human APIs in the environment has been acknowledged as an emerging environmental problem requiring scientific and regulatory attention. A crucial step in environmental risk assessment of APIs is the estimation of their environmental exposure potential. Since there are currently more than 4,000 different human APIs in use, monitoring individual APIs is practically impossible. The aim of the present study was to develop and validate a model for the estimation of environmental concentrations of APIs in Europe on a country-specific per capita consumption data. The starting point for modeling the environmental fate of APIs is country-specific per capita consumption data. Subsequently, the modeling chain follows the steps of excretion into the sewerage system, transport to and fate in WWTPs, emission into surface waters and, finally, environmental transport, partitioning and degradation. Unique features of the model include the extensive location-specific information about European WWTPs, the flexibility in modeling Europe’s hydrology and accounting for ionizing properties of APIs. The model was validated using several studies reporting API concentrations in the Rhine basin. API-specific data and characteristics (e.g. physicochemical properties and consumption data) were obtained from the literature. Site-specific and API-specific measurements were directly compared to estimated water concentrations at the relevant locations in the river network. From the results shown for the Rhine basin and preliminary results of some additional basins, it can be concluded that estimations can be made with great spatial and quantitative accuracy. However, model performance depends on factors such as the allocation of country-specific consumption over relevant WWTPs, accuracy of the estimated hydrology, provided consumption data and API-specific characteristics.

395 Occurrence and fate of the antidiabetic metformin and its transformation products
S. Tidler, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tuebingen / Analytical Environmental Chemistry; C. Zwieen, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tuebingen / Geosciences

Effluents of municipal wastewater treatment are major entry pathways for pharmaceuticals and their transformation products (TPs). A wide-spread compound is the antidiabetic drug metformin (MF) with its well-known main metabolite guanyl urea (GU). GU is formed in WWTPs. So far, no other TPs of metformin are reported in the water cycle. In this study, electrochemical experiments for simulation and identification of potential new TPs of MF were performed. In addition we investigated the occurrence and fate of MF and its TPs in WWT and surface water. Analysis was performed by LC-high-resolution-mass-spectrometry (HRMS) using HILIC (hydrophilic interaction chromatography) quadrupole-time-of-flight mass spectrometry (QTOF-MS). Four TPs of MF have been identified after electrochemical degradation. The proposed structures are 4-amino-2-mino-1-methyl-1,2-dihydro-1,3,5-triazine (2,4-AMT), 2-amino-4-methylamino-1,3,5-triazine (2,4-AMT), 2,4-diamino-1,3,5-triazine (2,4-DAT) and methylbiguanide (MBG). The mass error was below 3 ppm for all 4 TPs. However, the well-known TP GU could not be formed electrochemically. The TPs found are similar to those of a former study using gamma radiation (Collin et al. 2004). 24-hour mixed samples of wastewater in Southwest Germany were obtained for 7 consecutive days. Elimination of MF was 92 ± at an average influent concentration of 24 μg/L. GU concentrations were in the influences between 66 and 640 μg/L and in the effluents between 60 and 386 μg/L. A plausible reason for the occurrence and relatively high concentrations of GU compared to MF could be the formation of GU already in parts of the sewer system. The following oxidation products of MF have been detected for the first time: 2,4-DAT, MBG and 2,4-AMT. The concentrations of MBG ranged between 40 and 122 ng/L. For the other TPs no authentic standards were available, however TPs 2,4-DAT and 2,4-AMT showed similar increasing abundance trends from influent to effluent, which implies their formation during WWT. 3 grab samples of surface water affected by waste water showed relatively high MF (between 100 and 470 ng/L) and GU (between 3700 and 4500 ng/L) concentrations. MBG was in the range between 10 and 30 ng/L. In addition, 2,4-DAT was detected. Its response was in all three samples about 40 % of the response in the WTW influent samples. The study is performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Wuerttemberg

396 Development of biotransformation half-life QSARs and PBT assessment in Pharmaceuticals and Personal Care Products (PPCPs) in European surface waters
E. Papa, A. Sangion, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; P. Gramatica, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA)

Pharmaceuticals and Personal Care Products (PPCPs) are of particular interest for the refinement of Pharmaceuticals and Personal Care Products (PPCPs) in European surface waters. Analysis was performed by LC-MS. Four TPs of MF have been identified after electrochemical degradation. The proposed structures are 4-amino-2-mino-1-methyl-1,2-dihydro-1,3,5-triazine (2,4-AMT), 2-amino-4-methylamino-1,3,5-triazine (2,4-AMT), 2,4-diamino-1,3,5-triazine (2,4-DAT) and methylbiguanide (MBG). The mass error was below 3 ppm for all 4 TPs. However, the well-known TP GU could not be formed electrochemically. The TPs found are similar to those of a former study using gamma radiation (Collin et al. 2004). 24-hour mixed samples of wastewater in Southwest Germany were obtained for 7 consecutive days. Elimination of MF was 92 ± at an average influent concentration of 24 μg/L. GU concentrations were in the influences between 66 and 640 μg/L and in the effluents between 60 and 386 μg/L. A plausible reason for the occurrence and relatively high concentrations of GU compared to MF could be the formation of GU already in parts of the sewer system. The following oxidation products of MF have been detected for the first time: 2,4-DAT, MBG and 2,4-AMT. The concentrations of MBG ranged between 40 and 122 ng/L. For the other TPs no authentic standards were available, however TPs 2,4-DAT and 2,4-AMT showed similar increasing abundance trends from influent to effluent, which implies their formation during WWT. 3 grab samples of surface water affected by waste water showed relatively high MF (between 100 and 470 ng/L) and GU (between 3700 and 4500 ng/L) concentrations. MBG was in the range between 10 and 30 ng/L. In addition, 2,4-DAT was detected. Its response was in all three samples about 40 % of the response in the WTW influent samples. The study is performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Wuerttemberg

86 SETAC Europe 28th Annual Meeting Abstract Book
The University of York / Natural and Built Environments; R. Ashauer. The University of York / Environment: A. Boxall. University of York / Environment Department. The majority of active pharmaceutical chemicals (APIs) currently in use are ionisable and may become charged at environmentally relevant pHs. Previous research has shown that the accumulation of a molecule in aquatic invertebrates depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to account for this accumulation. Assessed were the reproductive capacity of non-target organisms in relation to pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitriptyline, an antidepressant compound, in Lymnaea stagnalis. Toxinokinetic (TK) parameterisation and the underlying experiments involved the measurement of uptake and toxicity of amitriptyline at four medium pHs (5.5, 7, 8, 9). To simulate accumulation at the landscape scale, we used the generated toxicokinetic parameters in combination with measured monthly concentrations of amitriptyline in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data from two other pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4. Predictions of internal concentrations of amitriptyline in L. stagnalis varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Foss (which had a concentration range of 0.52-2 pmol/g and a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.29-2.9 pmol/g and a pH range of 7.41-8.44) and accumulation increased during the course of the year. Even though the model underestimated the internal concentrations by a factor of 2 and 4 in laboratory experiments conducted at pH 7 and 8 respectively, the general approach worked reasonably well to obtain internal concentrations. This study revealed important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress

398 Waterplants in Risk Assessment - Selection of Potential Plant Species - Impact of Different Test Guidelines G. Consiglio, Eurofins Agroscience Services Ecotoc GmbH When results of standard laboratory tests show an unavoidable high risk, aquatic higher tier tests are needed to reduce uncertainties. In case there is a high risk for aquatic plants additional species could help to reduce these uncertainties for risk assessment by performing Species Sensitivity Distribution (SSD) tests. However, it is not clear which criteria are used for selection of test species and which guideline is recommended for adaptation for non-standard species. Most tests were performed based on the Lemu guideline OECD 221, the two Myriophyllum spicatum guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum spicatum, Sediment contact test with Myriophyllum aquaticum (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (Aquatich Macrophyte Risk Assessment) group. Relevant was that the most important aspect of plant selection is the model for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.

399 Applying the EFSA Scientific Opinion on NTPT: Testing non-crop species and the reproductive capability of selected species under greenhouse conditions A. Duffner, D. Ripperger, C. Groening, P. Mack, Eurofins Agroscience Services Ecotoc GmbH; S. Knaebe, EAS Ecotoc GmbH / Ecotox Field; T. Moser, Eurofins Agroscience Services Ecotoc GmbH Agriculture is the dominating land-use of the EU member states by covering nearly half of the surface area. Using herbicides to reduce weed competition in agricultural areas can adversely affect non-target terrestrial plants growing at field margins. According to the recent EFSA Opinion for non-target terrestrial plants (2014) one important goal is maintaining the biodiversity of plant species in the agricultural area. It is therefore recommended to include also non-crop species in the testing scheme from the list provided in OECD guideline 208 and 227 to assess the life-cycle with flowering and seed production. The objective of this study was to assess the viability of generative traits of non-crop species for risk assessment. For this purpose generative traits were evaluated if they provide more relevant information for the risk assessment. For this purpose they were compared with the vegetative traits, such as mortality and biomass production, which are currently assessed in the OECD guidelines 208 and 227. The selected non-crop species are included in commercially available seed mixtures for flowering strips. Our experimental design consists of one control and four different herbicide application rates, with 6 replicates. The field rate was considered as highest, the others as reduced application rates. The number of flowers and plant height were assessed for selected species to evaluate differences in development and flowering. In addition, seeds were sampled to evaluate differences in seed quantity and quality. Furthermore, the results will be compared to a non-target terrestrial plants pilot field study (Knaebe et al. 2017; Participation in SETAC Europe 2017). References: EFSA PPR Panel (2014). Scientific Opinion addressing the state of the science on risk assessment of plant protection products for non-target terrestrial plants. EFSA Journal 2014;12(7):3800, 163 pp. OECD (2006). Test No. 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test. OECD Publishing, Paris. OECD (2006). Test No. 227: Terrestrial Plant Test: Vegetative Vigour Test. OECD Publishing, Paris.

400 Predicting plant community level effects of herbicides based on monocolulture dose-responses: Testing the plant community model IBC-grass with experimental data

I. Hein, University of Potsdam / Plant Ecology and Nature Conservation; S. Hein, Bayer AG / Effect modelling; C. Mihan, Bayer CropScience AG / Ecotoxicology; T. Preuss, Bayer AG / Environmental Safety; F. Jeltsch, University of Potsdam. Ecological models are rarely found in terrestrial plant ecotoxicology and risk assessment. Especially on community-level, the number of suitable plant models is scarce. Existing models are often not validated with experimental data, although the validation of ecological models is important for the credibility for risk assessors. Nevertheless, ecological models are a suitable tool to extrapolate individual-level greenhouse experiments to the plant communities in the off-field. Especially bearing in mind that protection goals for non-target terrestrial plants as defined by EFSAs are on population and community level. Reuter and Siemoneit-Gast (2007) performed an experiment that includes not only the test of monocoltures but also the test of small artificial communities consisting of 6 different plant species. This study is suitable to be coupled and compared to a plant community model, since it covers the population as well as the community level. We adapted the plant community model IBC-grass to the settings of the empirical study by Reuter and Siemoneit-Gast (2007). Specifically, we analyzed to which degree the model is able to represent realistic community level effects not only by comparing visual patterns but also by calculating model adequacy and reliability as a measure for the model fit. The predicted effects of the model IBC-grass show a good agreement with the experimental data, for the monocoltures as well as for the communities. Model adequacy was lower in the monocoltures. However, model adequacy increases in the communities. In general, model reliability is high in the monocoltures, but low in the community set up if the effect of the selective herbicide is simulated. Population level and community level effects on plant biomass predicted by the plant community model IBC-grass were in good agreement with the measured effects from the experimental study of Reuter and Siemoneit-Gast (2007). This agreement indicates the model is able to reasonably represent intra- and interspecies competition and predict community level effects based on dose-response data. Therefore, the model can serve as an important tool for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.

401 Use in risk assessment of recovery in plants from exposure to chemicals T.A. Springer, EAG Laboratatories / Specialist Projects & Histology; H.O. Krueger, EAG Laboratories / Aquatic, Plant and Insect Toxicology; J.W. Green, DuPont / Data Science and Informatics The plant interest group of SETAC has a committee working on the topic of recovery and this presentation concerns statistical issues arising from this work. Traditionally, evaluating the risk of chemicals to plant species involves assessing both lethal and nonlethal effects, but little or no consideration is given to whether the effects at the population or community level are transient or persistent. Considering the ability of plants to recover after the exposure to a chemical is important when evaluating effects on populations conducting a risk assessment. For example, a young plant in a vegetative vigor study may show damage after a day or two, but after two weeks of growth that damage may no longer be apparent as old damaged leaves have senesced and only new unaffected leaves are visible. While it is relatively easy to design studies to assess recovery of vegetative growth in terrestrial plants, this may not be indicative of recovery of the ability of a population of plants to sustain itself. In algae or lema studies, an aliquot of cells can be transferred to untreated media at the end of a test and after several days, the growth rates of the affected groups may approach that of the controls indicating recovery. Recovery in terms of growth rate of these simple aquatic plants is likely to be indicative of a population’s ability to sustain itself. In more complex mesocosm studies the concept of recovery is even further
complicated by seasonality, changes in nutrients, recolonization, competition, and other factors. Terminology and methodology need to be standardized if the concept of recovery is incorporated into evaluations of chemicals. For some plant types and properties, recovery is contingent upon the timing and duration of exposure and extent of injury. In such cases, the definition of recovery must specify timing and duration of exposure in the operational definition. Examples of recovery in laboratory studies for algae, Lemma, and myriophyllum studies will be presented as well as results from mesocosm studies. Statistical procedures and experimental designs will be presented for these examples and interpretation of results will be discussed.

402 Aquatic primary producers and plant protection products: endpoints and level of protection achieved in the first tier of the risk assessment scheme S. Duquesne, UBA, Federal Environment agency; L. Himmelmann, S. Matezki, M. Solé, K. Swarowsky, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV plant protection products

In the risk assessment for aquatic primary producers exposed to plant protection products (PPP), the endpoint (EP) corresponding to 50% inhibition of growth (EC50) is used in the first tier. The EC50 can be expressed as inhibition of the average specific growth rate (ErC50) or as reduction in biomass, calculated from yield (EyC50) or as the integral under the growth curve (EbC50). The lowest available EP among ErC50, EbC50 or EyC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use ER50S since it is a more robust endpoint. However, it is not yet clear if the protection level achieved is sufficient. This work shows that this new approach (i.e. selecting ER50S) shifts thus the level of conservatism of a factor of 6.9 for algae and Lemma sp, respectively. It also shows that the level of protection achieved for primary producers becomes insufficient in 59% of the cases, since the Tier 3 Regulatory Acceptable Concentrations (RACs) from micro-/mesocosm studies (considered as surrogate reference Tier) are lower than the Tier 1 RACs from standard toxicity tests. The results demonstrate that the intended level of protection is currently reached in only 41% of the cases versus 69% of the cases previously. In addition, this work explores which combination of EC50, (E(CIn, so etc.) and assessment factor would ensure an adequate level of protection. Recommendations are provided for an optimization of the risk assessment.

403 Poster spotlight: WE152, WE153, WE154

Mapping percentile statistics of element concentrations in moss collected from 1990 to 2015 in forests throughout Germany

W. Schröder, N. Nickel, University of Vechta / 2

Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss samples have been collected in about 7500 sites in up to 36 countries. Considering the chemical determination of heavy metals (since 1990), nitrogen (since 2005), and persistent organic pollutants (since 2010) in moss specimens, quality control and statistical evaluation was conducted according an harmonized methodology [1].

Mapping the percentile statistics of heavy metals and nitrogen concentration in moss sampled in forests across Germany is the focus of this paper. Thereby, element- and survey-specific as well as heavy metals and surveys integrating statistical evaluations and GIS-mapping were performed. Cr, Hg, Sb and Zn show, contrary to Fe and Pb, no constant decrease of element concentrations, but an intermediate increase between 2000 and 2005, which did not continue until 2015. Al, As, Cd, Cu and V stagnated between 2000 and 2005. Hg from 2005 to 2015. Therefore, Cr, Sb and Zn will be focused in this paper together with Cd, Hg, Pb and N which are of priority according to the Convention on Long-range Transboundary Air Pollution. Survey-specific statistical analyses corroborate that the spatial patterns of element concentrations in moss are changing across time. The long-term information on the percentile statistics of bioaccumulation of atmospheric deposition in moss is essential for further scientific evaluation as well as for measurements and reporting of nature protection and environmental management. Reference: W. Schröder, N. Nickel (2017) Reorganisation of a long-term monitoring network using moss as biomonitor for atmospheric deposition in Germany. Ecological Indicators 76:194-206. [2] Schröder W, Nickel S, Völksen B, Dreyer A. (2017) Nutzung von Bioindikationsmethoden zur Bestimmung und Regionalisierung von Schadstoffen in der Umwelt (Ökospezifische Nährstoffe, Schadstoffe). In: S. Matezki, S. Solé (Hrsg), Schadstoffe und Schutz der Umwelt. S. 435-447. Verlag Bund, Berlin.

406 Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geometrophy

J. Franzaring, A. Fangmeier, University of Hohenheim / Institute of Landscape and Plant Ecology; L. Paoli, University of Siena / Dept. of Life Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; S. Schlosser, University of Hohenheim / Core Facility Hohenheim; E. Monaci, University of Siena / Dept. of Environmental, Earth and Physical Sciences

Passive biomonitoring is being used for many years to assess changes in the state of the environment. Existing programs make use of international, national, regional and local monitoring networks addressing the effects of the widespread deposition of air pollutants and eutrophying compounds and the accumulation of these in e.g. forest and agricultural ecosystems. Multi-element analyses and survey effects on food-chain bioavailability. However, plants differ in the uptake of essential and non-essential inorganic elements and organic pollutants and the accumulation varies over time and space mainly due to the different geochemistry and climates in different regions. Here we report on the results of a biomonitoring study using holm oak (Quercus ilex L.) and two pine species (Pinus nigra J. F. Arnold and Pinus pinaster Ait.), i.e. evergreen deciduous and coniferous trees, in forests of northern Germany. Leaves and needles were sampled at different locations in the Mount Amiata and Colline Metallifere region in spring 2017 and the samples consisted of three age classes. While half of the analyses were performed on unwashed samples, the other half rested on samples that were thoroughly rinsed with deionized water prior to the analyses. ICP-MS, ICP-OES and CNS elemental analyses were applied for the determination of Cu, Zn, Cd, Ca, P, Al, Sr, Ba, Cr, Ni, V, Fe, Hg, P, K, Mg, As, Pb, Cd, Zn, Cu and S. From the significant differences in element concentrations and patterns between the tested species, regions and sites, differences between the washed and unwashed samples was less pronounced indicating that deposition of dust does not play a great role in the area. On the other hand, our preliminary analyses showed significant differences in element concentrations between different age classes, which relate to the availability, translocation, accumulation or growth dilution of plant essential and non-essential elements. Multi-element analyses and nutrient ratios can serve to differentiate between the characteristic geochemical and species-specific patterns and the positive derivation from these patterns points to the exceedance of element levels due to pollution and eutrophication. Biomonitoring in post-mining areas serves to identify pollution hotspots and can be used as a key component in controlling the success of land reclamation for agriculture and landscape management.

407 Examining historical trends in diet and contaminant exposure in bats using bat guano deposits from Jamaica

L. Gallant, University of Ottawa / Department of Biology; C. Grooms, Queens University / E. Kimpe, University of Ottawa / Department of Biology; J.P. Smol, Queens University / Biology; W. Bogdanowicz, Museum and Institute of Zoology;
J.M. Blais, University of Ottawa / Biology

Bats are excellent ecological indicators owing to their long life span, global distribution, and predictable responses to environmental stressors. Bats play important roles in pollination, seed dispersal, and insect population control and thus it is important to determine whether bat diets change over time as a result of exposure to contaminants such as metals. Bat guano deposits are of particular use as they may serve as natural archives for the cave environment and preserves stable isotopes and metals which allows for the determination of historical exposure to contaminants as well as any fluctuations in diet. This research provides the rare opportunity to examine two bat guano deposits from Jamaica: bat guano was heavily mined for gun powder and fertilizer and as such, there are few bat guano deposits that have been unaltered by human exploration or exploitation. The objective of this research is to reconstruct historical changes in diet and contaminant exposure to bats in order to better understand how anthropogenic activity affects these high trophic level mammals. We constructed the 214Pb, 10Cs, and 13C dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years-old. We constructed the δ13N, δ13C, and δ15S profiles in order to determine the long-term dietary trends in the bat guano deposits. Preliminary results suggest that the 3,000-year-old bat guano deposit is tracking a change in stable isotopes associated with the agricultural history of Jamaica, specifically, the introduction of: nitrogen fertilizers, the Bordeaux mixture, and sugarcane. We also examined the sterol profiles in the bat guano deposits for the purpose of determining more specific dietary information. Recent peaks in cholesterol and stigmastanol, for example, could be evidence of fluctuations in feeding habits (or bat colony composition) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the bat guano deposits associated with contaminant exposure in relation to the onset of the Industrial Revolution, a period characterized by an increase in atmospheric emissions of metals owing to increased mining and production. Lastly, we present the decrease in 214Pb/210Pb within the bat guano deposit in association with the introduction of leaded gasoline.

408 Perfluoroalkyl substances and metallic elements in South African dragonflies

H. Boitmaan, North-West University / Unit for Environmental Science and Management; V. Lesch, North-West University; Y. Shibata, National Institute for Environmental Studies / Fellow; A. Kinoshita, National Institute for Environmental Studies

Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metallic contamination has been carried out in South Africa. Adult dragonflies' profiles have been analyzed for PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult dragonflies were collected and analysed for PFASs and metallic elements. The results indicated that dragonflies from farming areas had significantly lower PFAS concentrations than sites located closer to industrial areas (median 2PFASs of 0.32 ng/g wm (wet mass) for Nelspruit (0.32 ng/g wm) compared to the industrial site of 3.7 ng/g wm). Each PFASs was present in the dragonflies' samples. PFAS concentrations were observed in all dragonflies, regardless of body size and habitat type preference are suitable indicators of environmental metallic elements. Sites located near wastewater treatment plants had elevated concentrations associated with mining and industries. Dragonflies from sampling sites near potential pollution sources that seemed to have isolated water sources, showed lower metallic element concentrations when compared with other sites. Based on these results we conclude that dragonflies would be excellent indicators of environmental metallic elements and PFAs.

409 Bioavailability of Arsenic and Antimony co-contamination to vegetable crops in agricultural soils

L.P. Froudawata, University of Wollongong / School of Chemistry; A. Holland, La Trobe University / Centre for Research in Environment (CRE) and (C) School of Chemistry; A. G. V. Banerjee, University of Wollongong / School of Science and Engineering Antimony (Sb) is an emerging contaminant that is associated to behave in a similar way to arsenic (As). Sb and As often occur because of mining. Bioaccumulation and phytotoxicity of As is well studied, but there is little evidence on Sb and its interactive effects with As. Metallloid accumulation in agricultural soils may present health risks and hazards to humans and ecosystems through direct ingestion or contact with contaminated soil and food, a reduction in food quality (marketability) via phytotoxicity and reduction in land usability for agricultural production. Plant bioassays allow inferences regarding the potential toxicity of contaminants. The phytotoxicity in the contaminated soils is governed by the bioavailability of the contaminant, which in turn is influenced by soil physical and chemical characteristics, contaminant species and the plant species of plant. However, it is still unclear the impacts of ageing of agricultural lands on the co-contamination of As and Sb on alternation of crops. Our study evaluated the potential use of vegetable crops to identify and assess the bioavailability and toxicity of As and Sb in co-contaminated soils using bioassays. Water spinach and choy sum are herbaceous leafy vegetable belonging to the morning glory (Convolvulaceae) and mustard (Brassicaceae) families, respectively. Our study compares the soil characteristics in terms of total and bioavailable metal fractions with plant accumulation and toxicity data. Plant toxicity parameters (tissue biomass and lengths) were used to evaluate impacts of contaminant exposure on plant productivity. This information was used to understand the tolerance of plants grown in As and Sb co-contaminated soils, and the risks associated with As and Sb co-contaminated soils. This was done as single element and mixed metal exposures. Test soils were silty sand and slightly acidic. Bioavailable As and Sb in soils increased proportionally with total metal concentration. A clear increase in the tissue accumulation of As and Sb was observed with increasing bioavailable metal fraction for both individual (As and Sb) and combined (As+Sb) treatments. Vegetative productivity decreased when grown in As only and As+Sb combined contaminated soils. Sb contamination in agricultural soils poses a greater human health risk and hazard than As only and As+Sb co-contamination, because Sb accumulates in edible crops with no observed phytotoxicity or reduction in the vegetable productivity.

Systems ecoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (I)

111 Transcriptomic responses of the endangered freshwater mussel Margaritifera margaritifera to trace metal contamination

A. Conti, T. Pieroni, University of Bordeaux / UMR EPOC CNRS 5805; I. Thébault, Université de Breté / LEMAR UMR 6539 CNRS/UBO/IRD/Ifremer; C. Kjoppel, INRA Institut National de la Recherche Agronomique / Plate-forme bio-informatique Genotoul, Mathématiques et Informatique Appliquées de Toulouse; J. Bélec, Université de Breté / LEMAR UMR 6539 CNRS/UBO/IRD/Ifremer; F. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; M. Baudrimont, Université de Bordeaux / UMR EPOC CNRS 5805; J. M. Blais, University of Ottawa / Biology

Dicitofenac (DCF) has become a major contaminant, causing environmental and ecological risks in coastal waters and human health problems. However, the risk assessment of DCF remains challenging due to the complexity of environmental, biological and ecological processes by which water quality might affect freshwater mussels. To investigate this effect further, mussels were classified into 3 age classes. In young, middle-aged and old animals, transcription levels were mainly explained by Cu, Zn and age, respectively. This suggests differences in the molecular responses of this species to metals during its lifetime that must be better assessed in future ecotoxicology studies.

111 LC-HRMS based-metabolomics to highlight biotransformation products and effects of diclofenac in Mytilus galloprovincialis

F. Courant, Université de Montpellier - UMR 5569 Hydrosciences / UMR Hydrosciences; B. Bonnefille, H. Fenet, Université de Montpellier / UMR Hydrosciences; E. Gomez, Université de Montpellier, Hydrosciences Montpellier UMR 5569 / UMR Hydrosciences

Diclofenac (DCF) has become a major contaminant of interest as shown by its inclusion in the EU Water Framework Directive (2015/495/EC). However, relatively little is known regarding its biotransformation effects and interactions in the Mediterranean mussel. Environmental metabolomics affords several advantages to study both topics. The metabolome refers essentially to i) the “endometabolome”, constituted by endogenous metabolites, and to ii) the “xenometabolome”, in reference to xenobiotics and their biotransformation products [1]. Metabolomics profiles acquired through mass spectrometric techniques may reveal the exposure by direct detection of xenobiotics and their metabolites (xenometabolome investigation) and effects by the detection of endogenous metabolites which concentrations may differ from physiological levels following the exposure to xenobiotics. However, this approach is not feasible, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to both a xenometabolome and (endometabolome) investigation. To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation). To demonstrate the approach feasibility, an experiment was carried out whereby marine mussels were exposed for 7 days to an endometabolome (endometabolome investigation).
4'-hydroxy-diclofenac, and 10 were phase II metabolites such as amino acids conjugates. Five were reported for the first time in an aquatic organism. Regarding the effects, two main metabolic pathways were found to be impacted by diclofenac exposure. The tyrosine metabolism was mostly down-modulated and the tryptophan metabolism was mostly up-modulated. To our knowledge, such DCF effects on mussels have never been described despite being of concern for these organisms, since amino acids and serotonin are involved in osmoregulation, and in gamma release in mollusks [2-4]. Our results highlighted potential impairment of mussel osmoregulation and reproduction following a DCF exposure in agreement with previous publications that have shown reproductive disturbance following DCF exposure in other aquatic organisms such as xenopus [5] or fish [6].

412 Metabolomics used to link affected molecular pathways with behaviour outcomes after a single dose of pesticide exposure in zebrafish

P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health; H. Viberg, I. Lee, S. Buratovic, P. Eriksson, Uppsala University

Worldwide, serious concern has arisen about the increased incidence of learning and developmental disorders in children. From a scientific point of view, there is no doubt that exposure to neurotoxic chemicals during early brain development can adversely affect learning and development. Various recent epidemiological studies have indicated that exposure to low doses of environmental bioologically active contaminants (e.g. pesticides) during human development can have deleterious effects on cognitive development in childhood. The European commission-funded project DENAMIC "Developmental Neurotoxicity Assessment of Mixtures in Children" investigates neurotoxic effects (e.g. learning and developmental disorders) of low-concentration mixtures of pesticides and a number of common environmental pollutants in children. We focus on (subclinical) effects on learning (cognitive skills) and developmental disorders in children (e.g. ADHD, autism spectrum disorders and anxiety disorders). The aims are to develop better and sophisticated tools, procedures and testing methods to screen compounds for (developmental) neurotoxicity, and to improve our understanding of chemical exposures and the observed effects (www.denamic-project.eu). As part of the project, a new alternative assessment strategy based on a combination of in vitro, in vivo assays, omics, and human exposure assessment is under development in order to prioritize compounds, and to further investigate the pathways and mechanism involved in disorders and diseases. The final aim of DENAMIC is to reduce effects of environmental contamination on learning and developmental disorders in children. In the current study metabolomic pathway analysis was used to improve our understanding of the underlying molecular mechanisms of observed effects on behaviour and cognitive function after various pesticide and other contaminant exposures in mice.

413 Relationships Between Persistent Pesticide and Metabolomics Profiles in Tissues of Polar Bears From Hudson Bay, Canada

A.D. Morris, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; R.I. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division; M. Dyck, Government Of Nunavut / Nunavut Department of the Environment; B. Chandramouli, J. Cosgrove, SGS AXYX

Metabolomics profiles are comprised of targeted endogenous metabolites (< 1 kDa) such as amino acids (AAs), fatty acids (FAs), and membrane lipids such as phosphatidylcholines (PCs) to identify how changes in the metabolome relates to extrinsic factors, including e.g. exposure to persistent organic pollutants (POPs) and metals. Polar bears (Ursus maritimus) from Hudson Bay (Canada) are differentially exposed to complex mixtures of POPs and metals including total mercury (THg = inorganic + methyl mercury), and legacy and new POPs. In the present study, quantifiable profiles of 295 organic POPs and THg in fat and liver (n = 261) were analyzed using a comprehensive library of 4'835 compounds (SHB: n = 14) and Western Hudson Bay (WHB; n = 15) males. Male polar bears were collected for multivariate and univariate statistical analyses. Correlated compounds and significantly different or impacted physiological pathways were identified that may be related to differences in POP exposure or other environmental factors. Partial least squares discriminant analysis (PLS-DA) and variable importance in projection (VIP) were applied to the combined metabolite-contaminant profiles of these polar bears, and Spearman correlation analyses were used to establish relationships between metabolites and contaminants, as well as with other biological factors. Forty-one metabolites (membrane lipids, acylcarnitines (ACs), and symmetric dimethyl arginine (SDMA)), and 21 POP discriminated the subpopulations. Perfluorinated alkyl substances (PFASs), polybrominated diphenyl ethers (PBDEs), p,p'-dichlorodiphenyl dichloroethylene (DDE) and some ortho-polychlorinated biphenyls (PCBs) were greater in the SHB bears and changes in the metabolite concentrations had some consistency with previous laboratory studies. Arachidonic acid (ARA), glycerophospholipid and amino acid pathways

414 Integrative Omics linkage to reproduction effects of a fungicide in the soil invertebrate Folsomia candida

T.E. Simoes, S.C. Novaes, Polytechnic Institute of Leiria / MARE IPeLiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Sousa, University of Coimbra / Department of Life Sciences; B. Devree, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; T. de Boer, Vrije Universiteit; D. Roelofs, Vrije Universiteit / Department of ecological Science; N. van Straalen, Association of Rewild Environmental Scientists; ARES / Department of ecological Sciences; M. Lemos, Instituto Politécnico de Leiria / MARE IPeLiria

Due to high complexity of ecosystems, environmental risk assessment can be a challenging task and there is the need to develop and validate innovative and reliable tools and integrated approaches for fast detection of changes in population and community structures that can be applied by regulatory agencies. Folsomia candida is among the most sensitive invertebrates to soil fungicide, and has been selected as a genomic model organism for soil toxicology studies on non-target soil arthropods. This work aimed to determine the toxicity mechanisms of a widely applied fungicide formulation (Bravo5000®), with active compound chlorothalonil (CHT), in F. candida, by linking effects at different levels of biological organization like reproduction, gene expression and protein levels, following a time series exposure. Therefore, 5000 ppm and 5 ppm CHT were added to soil, followed by a 7-day series exposure. To find the reproduction EC50, several dilutions of the formulation were spiked according to nominal concentrations of the active ingredient. For the mechanistic assessment of effects, and to better understand the correlations between omics information through time, organisms were then exposed to the estimated EC50 of the formulation (plus control) and sampled at consecutive time points (2, 4, 7, and 10 days). Four replicates per treatment and time point were used (32 in total). CHT exerts its toxic effects primarily through binding to thiol-rich molecules (ex. glutathione), exhibiting often a multi-site activity and the results with the formulation were very indicative of these mechanism of toxic activity. Also in this study, results point for similar effects of the fungicide formulation mechanism involved in detoxification and excretion (also involving glutathione), normal cellular respiration and protein metabolism, leading to impairment in development and reproduction. The datasets presented highly significant positive correlations between the gene expression levels at a certain time-point and the correspondent protein products from the consecutive time-point, thus highlighting the importance of considering a time series design when investigating the impact of a contaminant. This approach could thus provide useful insights, exhibiting their relevance in toxicological studies and proving the importance of a time-series analysis in correlations between these datasets.

415 Using functional genomics to find mechanisms of herbicide toxicity in Chlamydomonas reinhardtii

A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; A. Betz, Eawag / UTOX

At present, environmental risk assessment of chemicals is limited to measuring physiological endpoints in model species. To test all chemicals that require testing, a shift to mechanistic-based testing is needed. However, neither direct molecular targets nor the stress pathways that lead to adaptation to chemical exposure are usually known. Finding the genes encoding sensitivity or tolerance to chemicals is one of the highest priorities of the (eco)toxicological research community. One of the best methods for gene function discovery is functional genomics based on high-throughput single-gene mutant phenotyping plus transcriptional and translational (such as chemical exposure) information of interest and mutants which are the most susceptible to the intervention and those that are most tolerant are found. We exposed a pooled library of loss-of-function mutants of Chlamydomonas reinhardtii to three herbicides that target photosynthesis: atrazine and diuron which target photosystem II, and which disrupts the transition of electrons from photosystem I to photosystem II which leads to production of reactive oxygen species. The pooled library was exposed to the EC20 concentration of each herbicide for 3-4 days, at which time samples from the library were taken for DNA sequencing to find mutants that have become enriched or have disappeared from the culture after exposure (compared with non-exposed control). The expectation was that the functional genomic profiles of atrazine and diuron would be similar, as the target of both chemicals is the same, while a different profile would be obtained for paraquat. This was indeed the case, with the profiles for both diuron and atrazine enriched for mutants of genes involved in the photosynthesis. The profiles of paraquat also included photosynthetic genes, but also several genes involved in defence against oxidative
stress and lipid metabolism. Finally, there were also several genes that were among the enriched separately for diuron and atrazin, which points to possible different secondary modes of action for both herbicides. While we are currently still analyzing the obtained profiles and individual genes, our results demonstrate that functional genomics is a useful method for discovery of molecular mechanisms of chemical toxicity.

416 Harmful effects of plastic litter and mitigation strategies in the Mediterranean Sea

M. Fossi, M. Baini, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment

Concern about the occurrence, quantity and effects of marine litter in the world's ocean and seas has grown rapidly in recent years, attracting interest from a wide range of stakeholders. Environmental NGO, the scientific community, the media and the general public. Mediterranean Sea, which is a crucial biodiversity hotspot and a critically polluted area, has been also described as one of the areas most affected by marine litter, including microplastics, in the world. Recent studies in the different regions of the basin suggested that some areas are affected by important concentration of microplastics and plastic additives, representing a potential risk for endangered species (baleen whales, sea turtles, filter feeders sharks) and for the all Mediterranean biodiversity. To cover the current knowledge gaps on this issue a harmonised methodological approach for the assessment of the marine debris impact on Mediterranean biodiversity is needed. The quantification of marine debris/microplastics in the marine environment can depend on several environmental factors and change according to multiple oceanographic features, and therefore, cannot reflect the potential impact on organisms and ecosystems. The information obtained by bionidicator species could better integrate the spatial and temporal presence of marine litter/microplastics in the marine environment. In addition, the use of bionidicators can allow to measure not only the occurrence of marine litter in the species and its environment but also the threat posed to organisms by the evaluation of contaminants accumulation and any ecological effect. A new integrated monitoring tool that would provide the information necessary to design and implement future mitigation actions in the Mediterranean basin is proposed. Applying ecological and biological criteria to the most threatened species obtained by statistical analysis, bionidicator species for different habitats and monitoring scale were selected. To assess the harm by marine debris ingestion a threefold approach, simultaneously measuring the presence and effects (accumulation of plastic associated contaminants and biomarker responses), can provide the harm and the sub-lethal effects to organisms related marine litter ingestion. The gaps pointed out by this research and the bionidicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

417 Impact of marine litter in the Mediterranean Sea: monitoring and specific reduction measures within MSFD

F. Giliani, IFREMER

Preliminary assessments of the state of the marine environment, monitoring and the formulation of environmental targets are perceived as part of the continuous management process within the MSFD. Of the 11 descriptors listed in Annex I of the MSFD for determining GES, Descriptor 10 has been defined as "Properties and quantities of marine litter do not cause harm to the coastal and marine environment". In 2016, the Revised Commission Decision identified four indicators for Descriptor 10, of which two are focusing on harm considering (i) The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned (indicator 10DC3), and (ii) The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects (indicator 10DC4). For these two indicators, Member States shall establish that list of species to be assessed and thresholds values for these levels through regional or sub regional cooperation. In the context of the Mediterranean Sea, we discuss the ongoing work that is focusing on the implementation of monitoring and reduction measures, defining constraints, protocols, better defining harm and research needs to support monitoring efforts and reduction measures. The analysis of existing data will reveal (i) the suitability of some approaches for better monitoring the adverse effects of litter, and (ii) the potential of visual observations of the sea floor for the measurement of interactions between litter and invertebrates as an approach for evaluating entanglement. Strategies for the implementation of monitoring are discussed, as well as risk assessment and the possible associated measures within MSFD.

418 Addressing the growing threat of marine litter: NGOs essential role in strengthening the science-policy-society interface

T. Vlachogianni, Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)

The growing urgency and complexity of interconnected societal challenges, such as marine litter, demand that they be addressed through the strengthening of the science-policy-society interface so as to provide the necessary conditions for translating research-based knowledge into effective action. NGOs are essential partners in promoting environmental protection and sustainable development. Their active participation at local, national and transboundary level in all phases of projects and processes, from their design, implementation in the field, operationalization, monitoring and evaluation, contributes not only to increased transparency, wide visibility and outreach of the project or process, but also to enhanced overall quality and increased ownership of the outcomes, as well as amplifying possibilities for replication of its activities. In full acknowledgement of the prominent role of NGOs in the realm of environmental governance, MIO-ECSDE, a Federation of some 130 Mediterranean NGOs working on Environment and Sustainable Development, in fulfilling its vision and mission, has developed and implemented a number of actions on the science-policy-society interface that address the growing threat of marine litter in the Mediterranean, ranging from the monitoring and influencing of relevant policies, all the way to hands on and pilot activities (e.g. within the framework of the IPA-Adriatic DeFishGear, the FP7 MARLISCO, the Interreg Med ACT4LITTER, the EU SWIM-H2020 SM, etc.). How marine litter and its inherent environmental, economic, social, political and cultural dimensions have been tackled by MIO-ECSDE illustrates the broad extent of involvement and interventions required for the protection of the marine and coastal. The term "biodegradable" could be misunderstood and induce the particular strengths that the NGO community brings to environmental governance, such as leadership, creativity, flexibility, entrepreneurship and capacity for vision and long-term thinking. As scientists call for more research on global environmental changes in an effort to gain a better understanding of the human induced implications for all of life on Earth, it remains an inconstant truth that if the term "biodegradable" was already produced, the state of many ecosystems would be different today. The NGO community has an essential role to play in terms of strengthening the science-policy-society interface towards an effective response from society on the issue of marine litter and other societal challenges.
Environmental risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (II)

424 Biodiversity patterns in the GLOBAQUA basins and their relationships with multiple stressors
N. De Castro-Catalá, Universitat de Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; I. Muñoz, University of Barcelona / Department of Biological Sciences, Ecology and Environment; M. Paunovic, University of Belgrade, Institute for Biological Research Kalogjini, I. Karouzas, A. Vourka, E. Smeti, L. Vardakas, Hellenic Centre for Marine Research, Institute of Marine Biological Resources & Inland Waters (HCMR); C. Borrego, M. Petrovic, Catalan Institute for Water Research ICRA, S. Sabater, ICRA Catalan Institute for Water Research; S. Diaz, M. Lopez de Alda, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry

425 Changes in pCO2 after the reproductive toxicity of common active pharmaceutical ingredients
G. Leone, Legambiente

“Science and awareness: a Mediterranean connection against marine litter” is the title of the voluntary commitment that Legambiente and the University of Siena presented at the last UN Ocean Conference in New York, in June 2017. There was a connection between scientific research and raising awareness built to tackle marine litter in the Mediterranean Sea by sharing experiences and developing new integrated action. In 2013, Legambiente started the monitoring of floating macro litter within Goletta Verde, one of the most popular campaigns of analysis and information about sea pollution. In the last few years, there has been an increase in the marine-litter-related activities, including surveys using citizen science and awareness raising projects. Following the Scientific Environmentalism purpose Legambiente applied official methods and protocols to contribute to the estimation of the marine litter amount in seas and along the coastline, cooperating also with national research institutes, universities and other research organizations. Now, thanks to the cooperation with the RPML of Mediterranean, a further step has been results, towards a more effective marine litter management at regional level. One of the latest developments of the UN Environment/MAP is the 2017 Mediterranean Quality Status Report (QSR) that dedicates two chapters on marine litter related to beach, floating, and seafloor marine litter.

421 Science and awareness: a Mediterranean Connection Against Marine Litter. First Results of the Commitment Presented at UN Ocean Conference
G. Zampetti, Legambiente

423 Final Remarks
G. Leone, UNEP/Mediterranean Action Plan

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (II)
acclimated to. Many species of algae are highly adaptive and can respond by growing rapidly after disturbance. However, the diffuse burden of chemical pollutants concomitantly present in freshwater ecosystems, can favour species of algae that are more tolerant to chemical pollution to the detriment of more adaptive ones. We carried out a field experiment, using a non-invasive mesocosm approach, to study the response of phytoplankton communities to combined physical and chemical anthropogenic stressors. We aimed at investigating if chemical pollution can induce significant shifts in phytoplankton communities by setting up replicates under both extreme events. An extreme meteorological event was mimicked by sampling and mixing phytoplankton communities over the entire water depth of the lake. The chemical stressors comprised a mixture of chemical pollutants added to the mesocosms at five increasing concentrations (typically considerably below the EC10 of individual substances). The mixture included 12 pharmaceuticals and personal care products commonly detected in lakes and rivers in Europe. In addition, a mixture isolated from treated waste water effluents was used as a treatment of its own. Individual level traits (cell size, pigments), community parameters (biomass, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 32 days experiment. Our results showed that contaminant contamination and environmentally relevant concentrations have a drastic persistent impact on the different levels of organisation of the phytoplankton community. At community level, contaminant decreased the photosynthetic yield. At higher concentration levels these effects persisted throughout the duration of the experiment, resulting in lower productivity and communities with contrasting. This suggests that diffuse chemical contaminants can disrupt the capacity of natural communities to handle environmental changes.

427 The role of multiple stressors in an Alpine river and the response of the macroinvertebrate community. M. Assuncao, University of Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; A. Bellin, University of Trento / Department of Civil, Environmental and Mechanical Engineering; E. Capri, Università Cattolica del Sacre Cuore / Institute of Agricultural and Environmental Chemistry; E. Stella, University of Trento / Department of Civil, Environmental and Mechanical Engineering; E. Capri, Universitat Cattolica del Sacre Cuore / Institute of Agricultural and Environmental Chemistry; I. Muñoz, University of Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; A. Bellin, University of Trento / Department of Civil, Environmental and Mechanical Engineering

In this study the combined effects of hydrological and chemical stressors on benthic macroinvertebrates are evaluated in order to explore the response of the biological community in relation multiple pressure factors. The Adige River, located in the Southeastern Alps, was selected as a case study because representative of a variety of stressors acting on the Alpine region. As expected, streamflow showed a seasonal pattern, with higher values in the spring-summer period; however, in some sites the natural hydrological regime was altered by the presence of hydropower plants, which management affected most low values of streamflow. Statistical analysis showed a clear seasonal and spatial pattern in both chemical and hydrological parameters; in detail higher concentrations of nitrate, Personal Care and Pharmaceutical products were found in winter season associated with lower hydrological parameters; in detail higher concentrations of nitrate, Personal Care and Pharmaceutical products were found in winter season associated with lower hydrological parameters. Changes in richness, diversity and composition of macroinvertebrate community are related with inputs of urban pollution along the river, and with hydrology, chiefly downstream hydropower plants. Pollution (nitrates and other compounds such as PhAc's and FCP) favor higher invertebrate densities but lower diversity, changes in thermal natural regime affects Plecoptera, and Gummarnus sp density and variability. This study lies in giving a comprehensive and general explanation of the response of biological communities to multiple stressors investigated in an Alpine environment; in particular the analyses performed allow to distinguish the main pressures that impact macroinvertebrates in the Adige river.


Anthropogenic activities have contributed to great environmental challenges: remarkable chemical contamination and dramatic climate change. Both factors strongly affect marine ecosystems and are expected to worsen in the future, threatening marine species’ welfare and survival. Yet, information on how fish will cope with the presence of chemical contaminants in the future is still extremely limited. Emerging and non-regulated pharmaceutical and personal care products (PPCPs) have recently become a great environmental concern, since these compounds are often discharged into the aquatic environments, but their elimination through conventional wastewater treatments is rather limited. Within pharmaceuticals of human use, venlafaxine (VFX) is one of the most ubiquitous in the aquatic environment, often reaching higher concentrations than other well-known psycho-active drugs, such as fluoxetine (i.e. Prozac). In this context, the aim of this study was to investigate for the first time the effect of seawater warming and acidification on VFX bioaccumulation in fish tissues, as well as the behavioural implications resulting from the exposure to these stressors (alone or combined), using juvenile meagre (Argyrosomus regius) as model organism. Overall, data evidenced that seawater temperature and pCO2 levels can strongly affect the bioaccumulation patterns of antidepressants in marine organisms. Furthermore, the distinct behavioural patterns observed when VFX contamination, acidification and warming acted alone or in combination evidenced that multiple environmental stressors should be considered when assessing fish behaviour under a future changing ocean. The results here gathered further strengthen the need to carry out greater research efforts to understand how multiple environmental stressors interact with each other.

429 A modelling approach to assess present and future land use pressures on a salmonid river: a case study in the River Tamar catchment (UK) M. Assuncao, Celas Lowestoft Laboratory; P.E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; M.G. Hutchins, Centre for Ecology and Hydrology

A linked-model approach was applied to the River Tamar catchment (Southwest, UK) to assess current and likely future impacts of land use practices on salmonid populations; Atlantic salmon (Salmo salar) and brown trout (Salmo trutta). Land use data were incorporated into a validated water quality model (QUESToR) at the sub-catchment scale and a baseline generated for the period of 2000 to 2012. Future scenarios of water quality were also generated based on land use practices recommended under ongoing catchment initiatives. Overall, the baseline water quality parameters found to be non-compliant with “Good Status” under the Water Framework Directive, or outside the freshwater requirements for salmonids, corresponded with reported land use pressures in the Tamar, namely, catchment-wide frequent elevated levels of inorganic phosphorus and, less frequently, suspended sediments. Tested future land use scenarios bringing improvements in inorganic phosphorus levels included upgrading technology at sewage treatment plants and the implementation of riparian buffer strips, combined with a corresponding reduction in livestock density. These improvements however, were marginal therefore the tested land use scenarios should be adjusted and/or new scenarios explored. Baseline seasonal average values for water quality parameters in different areas of the catchment explained 68% of salmon and trout fry density variation, and showed how different parameters might be affecting the density of these two species. Our results suggest that catchment pressures are contributing to the regulation of salmonid fry densities in some tributaries and upper catchment reaches. Moreover, they can be used to inform local and seasonal targeted measures, aimed at improving those water parameters most influential on fry densities. These types of measures are likely to bring the highest benefits to salmonid productivity in the catchment.

PBt/PvB & PMT/PvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (II)

430 Evaluation of PBt and Pvb substances based on exposure dynamics, use-specific impacts and costs for emission reduction or abatement in the context of REACH S. Schacht, Wageningen University / Social Sciences; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Kleijn, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Nendza, Analytisches Laboratorium A key element of the European chemicals legislation REACH is to ensure that the risks caused by substances of very high concern (SVHC) are adequately controlled. The two regulatory procedures adopted in REACH to control the risks arising from SVHCs are authorisation and restriction. Both regulatory instruments make use of specific impact and costs for emission reduction or abatement in the context of REACH,
target values (standards) by means of which it can be determined whether or not the costs of a control measure are excessive. This paper suggests an approach for the evaluation of PBT/vPvB substances by means of CEA that accounts for the complex environmental distribution patterns, and that allows balancing (long-term) impacts from PBT/vPvB use against costs for emission reduction and abatement. The approach proceeds along a sequence of steps and uses different analytic tools and data. Starting with a grouping and ranking of PBT/vPvB substances, exposure dynamics are analysed with a multimedia pollution approach. Based on the assessment of exposure dynamics in different compartments, impacts arising from the stock can be evaluated via different routes. To assess the cost-effectiveness and proportionality of possible (policy-) measures for PBT/vPvB control, the routes to impact evaluation are linked to assessments of costs for restricting or stopping a specific group of multimedia PBT/vPvB substances and to benchmarking against standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorocarboxylates (PFOS).

431 Grouping and relative ranking of the impact potential of PBT/vPvB substances for comparative assessments in the context of socio-economic analysis under REACH

M. Nendza, Analytisches Laboratorium; S. Hahn, Fraunhofer IEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; B. Vlaming, University of Antwerp / Department of Environmental Chemistry; S. Kappen, Wageningen University / Institute for Food, Nutrition and Integrative Health Sciences. The assessment of PBT/vPvB substances under REACH may evaluate long-term exposure dynamics and impact potential. Grouping and relative ranking of PBT/vPvB substances can support comparative assessments of either several substances with the same use, or for a particular substance with different uses (emission patterns) in the context of socio-economic analysis (SEA). The aim of the grouping approach is to use multimedia pollution chemistry with respect to its similarity of properties/behaviour with chemicals with known impacts, serving as points of reference for the impact evaluation. The relative ranking of PBT/vPvB substances is based on an impact score, which captures diverse properties and effects of target substances. The impact score consists of individual scores assigned to expected environmental stocks, possible effects of PBT/vPvB substances on the environment and on human health via the environment (toxicological benchmarks), and to other specific concerns. The resulting fingerprints of concern (pattern of the individual scores) and the overall scores for impact potential can be used for comparative assessments. For example, if similar fingerprints are observed for two substances with a similar use, the total score gives an indication which substance might be less (or more) critical. For 17 case study chemicals, data on partitioning properties (log Kow, log Koa), stocks in water/sediment and soil, long range transport potential (LRTP), overall persistence (Pov), toxicological benchmark values for water and soil, CMR properties (H-phrases), endocrine disruption (ED) potential, production/emission volume, and use pattern have been collected from REACH dossiers or estimated with suitable tools. The examples illustrate the potential of the approach to combine and use data from different sources. Further, a step-wise approach for selecting and evaluate differences of PBTs/vPvBs on the socio-economic impact can be envisaged for a set of candidate chemicals. Based on current knowledge, this grouping and relative ranking can guide the formation of concern-based categories for a possible read-across or comparative evaluation of impact potential of PBT/vPvB substances. Acknowledgement – This work was funded by the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs under Contract number: 30-CE-083097200-26 ‘Approach for evaluation of PBTs subject to authorisation and restriction procedures in context of socio-economic analysis’.

432 Interpretation of non-extractable residues (NERs) in the persistence assessment

U. Jönckne, Federal Environment Agency (UBA) / IV 2.3 Chemicals; V. Bommert, European Chemicals Agency ECHA; I. Doyle, Environment Agency / Environment Directorate; R. Hornek-Gaaster, Environment Agency Austria; A. Kapanen, European Chemicals Agency - ECHA; M. Kästner, Helmholtz centre for environmental research – UFZ; ReinerRichterBiotechnology; J.R. Pelotola-Thiis, ECHA-European Chemicals Agency; L. Ribeiro, A. Schäffer, Institute for Environmental Research RWTH Aachen University; M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; F. Schmidt, C. Leake, Bayer AG Non extractable residues (NER) so called “bound residues” of plant protection products are formed in soil as a result of degradation processes. Due to their inherent nature, analysis and further assessments of bound residues are challenging. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been reported. The method relies on the determination of natural amino acids as the main part of biogenic residues in soil. The amino acids were liberated via a digestion of the soil with 6 N HCl at 110°C. Within this presentation we focus on the utility and validity of this analytical method using 14C bromoxynil and an agricultural soil from Germany. As a model compound 55% of the radioactivity could be liberated and remained bound to the soil even after such a harsh digestion step. During further clean-up of amino acids further losses of radioactivity of approximately 40% of those liberated bound residues has been observed. Further analyses elucidated up to 50% of those unidentified losses, however, in total approximately 75% of bound residues stuck to the soil and therefore could not be identified or unambiguously assigned. However, 16% of the generated NER was extractable and could be assigned to amino acids. Both results indicate that bound residues will not contribute to future risks or hazards because they are on one hand not bioavailable or on the other hand they have been converted to natural biogenic residues like natural amino acids.

433 Quantification of different NER types in soil – Extraction matters

J. Hogeback, Federal Institute of Hydrology; D. Loeffler, D. Albrecht, A. Martin, M. Fligg, German Federal Institute of Hydrology; A. Wiemann, UBA Umweltbundesamt; G. Speichert, German Environment Agency UBA; A. Hoellrigl-Rosta, Umweltbundesamt / Section Plant Protection Products; T. Ternes, German Federal Institute of Hydrology. The formation of non-extractable residues (NER) of chemicals in soils and sediments is a critical issue for the environmental risk assessment of these compounds, as they may potentially be remodelised as parent or transformation product. However, a standardised or commonly accepted methodology for the characterisation and evaluation of NER does not yet exist. In scientific literature different groupings of NER – NER A, NER B, NER C and NER D are identified or unambiguously assigned. Howev
Acid (6 437 not simplistic) tools can play in instrumental role in bringing these insights closer to speaks to their heart and mind and that is relevant for their job at hand. This requires We will show examples of how this tool is applied for strategic goal setting as well important to assess first which methods are fit for purpose to support decisions in a outcomes. Results can have a different meaning in different context. Therefore, it's decision determines what support is needed and what's the relevance of the products, determine the long term company strategy or select the most sustainable It's a big difference if you want to make a decision about different opt.

Kahnemann, the Nobel Prize Winner, argues in his book "Thinking Fast and Slow". one of the first distinctions that are made when it comes to decision making. One of the important points he makes is that there are different kinds of decisions: fast and slow. Fast decisions are made quickly, often without much thought or analysis, while slow decisions are made slowly, with careful consideration of all relevant factors. This distinction is important because it helps us understand the different factors that influence decision making. For example, fast decisions are often influenced by emotions and intuition, while slow decisions are often influenced by rational analysis and data. This distinction also helps us understand the importance of having a clear decision-making process, including setting clear goals and objectives, gathering relevant information, and evaluating different options before making a final decision.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (I)

436 How to make LCA fit for purpose as decision making tool M. Rieger, PRe Sustainability; A. Asbeck, PRe Consultants / Consultancy; J. Coutillass, PRe Consultants

To understand how Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) can be improved to support decision making we first have to look at how decisions are made. One of the first distinctions that are made when it comes to decision making is between normative and descriptive decision making. The latter describes how people actually make decisions and that can be quite irrational, as also Daniel Kahnemann, the Nobel Prize Winner, argues in his book “Thinking Fast and Slow”. The first tries to define how to come to the best option, assuming that decision makers are fully rational and that the world can be modeled accurately. These are quite opposite ways of how decisions are made. The second distinction to be made is between what type of decisions are made, by whom and what the objectives are. It’s a big difference if you want to make a decision about different options for new products, determine the long term company strategy or select the most sustainable supplier. Even more so, the objectives will differ per organisation or even situation and thus the criteria will also be different. In other words: the context of the decision determines what support is needed and what’s the relevance of the outcomes. Results can have a different meaning in different context. Therefore, it’s important to assess first which methods are fit for purpose to support decisions in a specific context. To enable this, we want to introduce an intermediate step to determine whether LCA, LCT or any other assessment is best suited to answer the questions that are relevant in a specific decision making situation. For this goal we developed a tool to the wettability phase. The tool helps to specify what kind of assessment is needed for the specific situation and helps to identify the most appropriate method to use. We will show examples of how this tool works and other decision tools and how they can be used to support decision making in a more effective way. Keywords: fit for purpose, decision making, LCA, Sustainability Assessment; Presentation preference: platform presentation

437 Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Developments in the Biopharmaceutical

C. Chau, University College London / Department of Biochemical Engineering; N. Titchener-Hooker, University College London / Department of Biochemical Engineering; P. Lettieri, University College London / Chemical Engineering 6-Aminopenicillanic acid (6-APA) is the beta-lactam nuclei of penicillin and is the intermediate to most semisynthetic antibiotics. Manufacturing of the nuclei represents one of the largest production scale processes within the biopharmaceutical industry. Environmental burdens associated with the industry are poorly understood, due to limited life cycle assessment (LCA) studies in the literature, the paper presents a LCA of 6-APA production to illustrate the burdens manufacture places on the environment as a function of manufacturing location. We make recommendations for future development of large scale biopharmaceutical manufacture by drawing on our 6-APA analysis where necessary. A typical manufacturing process for 6-APA involves producing 2000 Tons of 6-APA per annum has been modelled under USA operating conditions and a LCA hot-spot analysis was carried out. A process at this scale has a global warming potential (GWP) of 143,000 tonsCO2eq/yr. which is largely caused by the high annual fossil fuel usage. The energy mix selected for the model is critical. Choosing a USA mix comprising mostly non-renewable resources provided the base case. Switching to the assured energy mix to a Brazil mix (constituting a higher proportion of renewable resources), the contribution to climate change was reduced by 15%. Manufacture in China and India where coal combustion is the main source for electricity; the emissions were significantly higher (20%). Other location dependent variables were inputted into the model in conjunction with the switch of energy mix. Depending on the location’s water scarcity, the burden of 6-APA on this dimension varies greatly. A case in point is the water usage was seen when switching production from US to China. This is due to the higher use of hydroelectric power in the national energy mix and lower abundance of water in China. Production itself is water intensive due to high volume required for fermentation media and cleaning. Thus, overuse of local freshwater may compete with other sectors, e.g. agriculture, accessing this resource. This suggests that location of production is a critical factor in the planning of biopharmaceutical manufacturing.

438 A SUSTAINABILITY PERFORMANCE-BASED METHODOLOGY AND TOOL FOR ECODESIGN: the case of transport infrastructures D. Le Peng, The University of Nottingham / Centre for Integrated Transport Planning; P. Mino, The University of Palermo; S. Bressi, University College London / Chemical Engineering; P. Lettieri, University College London / Chemical Engineering; J. Oliveira Dos Santos, IFSTTAR; S. Bressi, University of Palermo; S. Brodie, The University of Nottingham; J. Bryce, AMEC Foster Wheeler; V. Cerezo, IFSTTAR; T. Parry, The University of Nottingham; G. Di Mino, The University of Palermo

The importance of sustainability in transportation infrastructure has raised in response to the link between anthropogenic activity and global warming, such as climate change, as well as in consequence of the ongoing development of models quantifying the social and economic impacts resulting from infrastructure development. Therefore, addressing the sustainability of transportation infrastructures requires exploring the environmental, social, and economic impacts of technological options while balancing the often-conflicting priorities of road users and other stakeholders, at an early design phase of the infrastructure delivery process. That is a typical multi-criteria decision-making (MCDM) problem, in which the decision-makers need to measure the sustainability through a set of meaningful, representative and quantifiable criteria, balance the relative importance of those criteria and determine the sustainability sequence of multiple alternative technologies for fostering transportation sustainability. In order to help the decision-makers to effectively optimize the decision-making task, a decision support tool (DST) was developed in the scope of the training-through-research programme Sustainable Pavements & Railways Initial Training Network (www.superin.eu). It consists of a computational platform that implements a conceptual framework developed to quantify sustainability. It comes with a set of sustainability indicators tailored to both road and railway systems as well as several objective and subjective weighting methods. Amongst those belonging to the last category, the DST includes a set of default weights derived from an Analytical Hierarchy Process (AHP)-based survey that engaged stakeholders from different sectors and from several European countries. At last, the Preference Ranking Organization Methodology of Enrichment Valuation II (PROMETHEE-II) MCDM method is employed for prioritizing the best sustainable pavement and railway solutions at the design stage. The DST will be freely available and can be used at professional level, by professionals interested in advancing sustainability in transportation, as well as for educational purposes, to provide knowledge and educate on the use sustainability concepts and on what are the important issues to consider during the sustainable transportation decision-making process.

439 Influence diagrams and scoping for Life Cycle and Sustainability Assessment, an example from sustainable mining A. Cioth, GreenDelta; C. Di Noi, GreenDelta GmbH; D. Bizarro, GreenDelta; H. Wessman-Jukskelainen, VTT Technical Research Centre of Finland Life Cycle Assessment is a technique typically intended to provide a holistic assessment of environmental and possibly also social impacts over the entire supply chain and life cycle. However, LCA has limitations, for a variety of reasons. In this situation, it is interesting to investigate, for a given issue, the ideal portfolio of tools
Life Cycle Sustainability Assessment for Improved Space Mission Design

A.R. Wilson, M. Vasilé, University of Strathclyde / Department of Mechanical & Aerospace Engineering; K. Baker, Glasgow Caledonian University / School of Engineering & Built Environment

The adoption of the Paris Agreement and Sustainable Development Goals in 2015 has been the driver for a more coordinated global approach towards achieving environmental sustainability. However, to be successful, this vision must run through every sector of society and the space industry is no exception. In the context of renewed global awareness on environmental sustainability, Life Cycle Assessment (LCA) is an important environmental management technique for characterizing environmental impacts. Given the unprecedented increase in space industry activities, it is of utmost importance to assess the environmental impacts of products over their entire life cycle. The European Space Agency (ESA) began work on this topic in 2009, employing an internal concurrent design study called ECOSAT to consider the life cycle impact of the design, manufacturing, launch and operations of a satellite. Since then ESA has continued to develop LCA methodology for this sector, creating the first set of LCA guidelines for space systems in 2016 and now in the process of integrating LCA into the concurrent design process.

Whilst space-based LCA is still in its early stages, its further development relies on it being increasingly employed within the broader space sector to give parity across the industries. For this reason, moving towards space-based Life Cycle Sustainability Assessment (LCSA) is a logical next step which allows for the more holistic understanding of the space sector’s impact on the environment. Tailoring this integration for space systems will allow the industry to become more accountable and responsible for their operations by taking into account the full spectrum of life cycle sustainability issues associated with the operation of space systems. This paper will present the LCSA methodology used in an open-source platform under development at the University of Strathclyde, outlining the advantages and economic aspects with environmental LCA to evaluate the life cycle impacts of space systems. As adverse impacts are more difficult to modify the later into the design process that they are identified, the integration of LCSA into the concurrent design process is essential for the early mitigation of sustainability issues. As such, the intention of this platform is to help decision-makers choose sustainable technologies and products at the design stage by determining those that are not only cost-efficient, eco-efficient or socially responsible, but also ones that can easily justify and evidence their sustainability.

How can Agent-based Modeling improve decision making in Life Cycle Assessment?

A. Micolier, University of Bordeaux / ISM CyVi; F. Taillandier, University of Bordeaux / I2M GCE; G. Sonnemann, Université Bordeaux / ISM CyVi

Life cycle assessment (LCA) is now acknowledged as the worthiest methodology to evaluate environmental performance of whole system in a holistic way. Thus, it has been tempting to extend LCA to support decision making that, in some cases, will dramatically impair the feasibility of civil work realization. In this paper we present the LCSA methodology used in an open-source platform under development at the University of Strathclyde, outlining the advantages and economic aspects with environmental LCSA to evaluate the life cycle impacts of space systems. As adverse impacts are more difficult to modify the later into the design process that they are identified, the integration of LCSA into the concurrent design process is essential for the early mitigation of sustainability issues. As such, the intention of this platform is to help decision-makers choose sustainable technologies and products at the design stage by determining those that are not only cost-efficient, eco-efficient or socially responsible, but also ones that can easily justify and evidence their sustainability.

Characterization and management of excavated soil and rock

G. Mininni, CNR-IRSA; A. Sciotti, F. Martelli, Italtiere S.p.A

This paper describes some case studies relevant to management of excavated soil and rock (ESR) produced when tunnelling is performed using Tunnel Boring Machine with Earth Pressure Balance system (EPBs-TBM). ESR can be alternatively qualified as waste or as by-products depending on utilization conditions (in particular, certainly of further use) and on their characteristics (especially in terms of environmental and health protection requirements). Tunnels construction entails production of large quantities of ESR, up to several millions of tons. Their management as a waste certainly requires a huge amount of financial and environmental assessment, including biotopes, limit values of some contaminants should be fixed to consider ESR as by-products, the allowed treatments as normal industrial practice should be clearly stated. Current legislation may have a non-unique interpretation and therefore the operators are exposed to uncertainties. The general principles of fair competition inside Europe are totally disregarded.

REALIZATION OF ROAD GALLERY: ADVANTAGES, CRITICALLY AND FUTURE PERSPECTIVES

A. Selleri, Autostrade per l'Italia / direzione tecnica; S. Frisiani, Spea Engineering S.p.A.

For those who carry out public works at the service of the territory, which are the motorway routes, it is essential that in all phases, from approval to the realization of the work, the respect of the pre-established times in the project and the relevant regulations is guaranteed. In fact, time is a factor that directly affects the costs of execution and, above all, the costs borne by the community, which, in the event of bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to introduce simplifications in procedures with the latest updates, there are rare cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques. and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of the excavated soil, is added the paradox that, at equal environmental conditions, the same lands can be considered by-products or waste, even if deriving from the same pile and if produced with the same excavation system within the same work. A case that represents this situation well is the mechanized excavation technique, whose adoption often involves an excess of provisions that substantially increase the size of the characterization areas inside the building sites, and the observation times, against a null environmental advantage.

Environmental risk assessment and management of the material produced in tunnelling excavation

SETAC Europe 28th Annual Meeting Abstract Book

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The increasing use of Earth Pressure Balanced Shields (EPB-TBMs) in the tunnelling industry has been due to their advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher tunnelling speed. The performance of EPB-TBMs relies on the use of appropriate soil conditioning foaming agents containing water solutions of surfactants, mainly sodium lauryl ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used by permission if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its possible ecotoxicological effects on soil and water organisms. The ecological approach here reported, consisting of site-specific studies together with ecotoxicological tests performed on the real excavated soils, aims to fill the gap between the lack of threshold limits in soil and water for these multicomponent commercial products and the environmental protection. The studies are planned following a preliminary evaluation of the foaming agent treatment ratios to be used for the specific lithological characteristics of the excavated soils. Here we report the main steps of the environmental studies useful for producing a “Protocol for the assessment of environmental compatibility of the spoil material during the tunnelling in the construction site”. The aim of the protocol is to address engineering contractors and stakeholders (e.g. Railway and Motorway operators) on how to verify the environmental compatibility of excavated soil before putting it in the destination site. It is very important to highlight that the protocol (e.g. the ecotoxicological test selection) has taken into account the site-specific characteristics and the possible environmental exposure scenarios in order to protect ecosystems and human health.

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Mineral-based soil conditioner for EPB TBMs: An environmentally friendly alternative

M. Greenhill-Hooper, Imerys / Product Additives; H. Spengler, Imerys / Imerys Metacasting; G. Collard, Imerys / Product Additives; C. Egerton, Consultant / Tunnelling

A novel product, based on a natural mineral has been developed for use as a foaming and soil conditioning agent with earth pressure balance (EPB) tunneling machines (TBMs). It is available as readily water dispersible granules or pre-prepared aqueous suspension form and can be dispersed and diluted readily in water with low shear mixing. The resulting dilute suspension can be converted into a foam using an industrial foam generator, or by other mixing methods. It can be used with existing equipment found on EPB TBMs, without the need for further modifications and investments. The choice of the additive is based on a natural mineral widely distributed in the earth’s crust. It is virtually insoluble in water and has no known ecotoxicity. Specifically, there is an absence of toxic effects on two aquatic organisms (Danio rerio and Daphnia magna) and a demonstrated low risk to arthropods, earthworms and soil bacteria. In a recent study commissioned with an environmental consultancy, it was considered that excavated soil, in its natural state, would not pose a risk to the surrounding water environment. Compared with existing products it contains very low levels of synthetic chemicals, relying instead on the natural mineral component to stabilise foams by a completely different mechanism; one that is potentially less susceptible to the degrading influence of soils that can compete for the surfactants that are present in, and that stabilise conventional foaming agents. An independent laboratory have demonstrated a good stability of the foams produced using the product (half-life measurements of water drainage), and confirmed that mixtures of the foam with fine and coarse grained soils have the desired consistency and cone slump behaviour for EPB tunnelling. A series of specifically developed tests reveal that the addition of foam substantially reduces adhesion of the finer grained soils to metal surfaces. In practice this will translate to a substantial reduction in the clogging potential of excavated clay in the TBM cutter head and spoil conveyors, crucial for maintaining good advance rates. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.

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Quantification of Carbon Nanotubes in Complex Matrices: Possibilities of Electron Microscopy

R. Kaezi, A. Gogos, Eawag Swiss Federal Institute of Aquatic Science and Technology

Fascinating properties of Carbon nanotubes (CNTs) allow the development of novel materials with increased functionalities (e.g. reduced weight, increased strength). Nevertheless, CNTs do pose potential environmental and human health risks and reliable methods to quantify CNTs at low concentration in complex matrices are still lacking. In the following paper, a novel and unique shape of the CNTs to quantify these materials in complex matrices. Multiwalled CNTs (IRMM 382) suspected in either ultrahigh quality (UHQ) water or in soil
extracts were directly centrifuged on transmission electron microscopy (TEM) grids, resulting in an even distribution of the CNTs on the grids. Samples were investigated with a scanning electron microscope (SEM, Magellan XHR 400, FEI) operated at an acceleration voltage of 20 kV in emersion mode and using a bright field transmission electron detector. A ridge detection algorithm implemented in the image processing software Fiji was used to detect and characterize individual CNTs. These were quantified by counting the number of CNTs calculated based on the total length of all CNTs (provided by the ridge detection algorithm) detected on the images in combination with their thickness (20 nm), their density (1.4 g cm\(^{-3}\)) and the well-defined volume of suspension that was centrifuged on the TEM grids. CNTs were well separated on the TEM grids and an increasing number of CNTs was observed on images with increasing concentrations of CNTs in suspension. Plotting the calculated concentration of CNTs in suspension against the nominal CNT concentrations (10 \(\mu\)g L\(^{-1}\) – 100 \(\mu\)g L\(^{-1}\)) resulted in a linear relationship. The calculated and the nominal CNT concentrations were in good agreement at low CNT concentrations, but at high concentrations, the calculated concentrations underestimated the nominal values by a factor of ~2. Almost identical results were obtained from CNTs in UHQ water and in soil extracts (5 mg g\(^{-1}\)) indicating that the detection of the CNTs was not compromised by the presence of soil particles. Future experiments will focus on a selective removal of the soil particles by an additional treatment with diluted hydrofluoric acid. Initial experiments are promising and suggest that the detection limit of the methods can be lowered to 1 mg CNT/ kg soil, which would represent huge step forward in detecting of CNTs in complex matrices.

449 Monitoring for perfluorinated compounds, insecticides, and brominated flame retardants in the water of Daechung lake and Geum river basin

H. LEE, National Institute of Environmental Research (NIER) / Geum River Water Environment Research Center; Y. Cho, J. Khan, National Institute of Environmental Research; H. Lee, Environmental Science and Conia center; B. Lee, National Institute of Environmental Research / Han River water environment research center; B. Seol, M. Chae, S. Cheon, National Institute of Environmental Research NIER / Geum River Water Environment Research Center A multiresidue analytical method using LC-MS/MS was developed for perfluorinated compounds (PFCs), insecticides, and brominated flame retardants (BFRs) in water samples with the simultaneous SPE method. The ranges of recoveries were 97.3 – 105.0 % (PFCs), 95.0 – 117.2 % (Insecticides), and 72.5 – 86.4% (BFRs), with coefficients of variation of less than 15%. Method detection limit (MDLs) of PFCs, insecticides, and BFRs were 0.3 – 7.1 ng L\(^{-1}\), 3.0 – 3.7 ng L\(^{-1}\), and 5.1 – 11.7 ng L\(^{-1}\) respectively while limit of quantifications (LOQs) were 0.9 – 21.8 L\(^{-1}\) (Insectics and 15.4 – 35.0 nights L\(^{-1}\) (BFRs). For understanding the background levels of PFCs, insecticides, and BFRs in the river water, those compounds were monitored in Geum river main stream, So-ok stream, Jiwun stream, and Daechung Lake (Dam) every month (March to December) utilizing the developed method. The compounds of the highest detection frequency were PFPOA, PFHxSA, and dinotefuran (Insecticide), whereas BFRs were detected only in March and December, except for main stream. In conclusion, the trends were not observed on periodical and spatial characteristics and the background levels were secured for PFCs, insecticides, and BFRs in Geum river basin.

450 Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

Stacia Dudley1, Marcus Pennington1, Chenliang Sun2, John Trumble3, Jay Gan3
1Environmental Toxicology Graduate Program, University of California, Riverside, CA 2Department of Environmental Sciences, University of California, Riverside, CA 3Department of Entomology, University of California, Riverside, CA Reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water supplies, there is a growing need for new and sustainable means to meet the needs of citizens, industries, and agriculture. The use of recycled water for agriculture comes with the po

451 Occurrence of pharmaceuticals and their metabolites in Euthynnus alletteratus bile

J.M. Peña Herrera, Institute of Environmental Assessment and Water Research (IDAEA-CSIC) / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. Navarro, ICAIE-CSIC / Dept. Recursos marinos renovables; M. Solé, ICM-CSIC; S. Perez, IDAEA CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry The presence of perfluoroalkyl substances in surface waters has been attributed to the effluents of WWTP among others. The widespread occurrence of pharmaceuticals in the aquatic environment has raised concerns about their potential adverse effects on exposed wildlife. Little is currently known on exposure levels of drugs in fish, but some studies reported the detection of pharmaceuticals and endocrine disrupting compounds in this type of biota. Due to possible accumulation processes, pharmaceuticals and metabolites could be thousand times more concentrated in fish than in polluted living waters. By other hand, fish are known to possess a hepatic detoxification system which are likely capable of metabolizing pharmaceuticals taken up from polluted waters. Some studies proposed the analysis of bile from fish to evaluate pharmaceuticals exposure including the identification of metabolites by UPLC-HRMS. In this context, we propose the evaluation of the metabolism of frequently detected drugs in fish, performing a rapid screening of bile by HR-MS for the presence of stable intermediates. Fish were collected from different regions in the Mediterranean coast of Spain. Afterwards, their bile was isolated from the fish and analyzed for the detection of parent drugs and some metabolites listed in an in-house suspected list. A sampling campaign was planned to collect tuna fish, Euthynnus alletteratus, from the Mediterranean coast of Spain. Tarragona, Cartagena and Ceuta were chosen as sampling sites between 2015 and 2017. Bile samples were analyzed directly by UPLC-HRMS after a protein precipitation. The HRMS data allowed screening for suspected pharmaceuticals and their metabolites and provided plausible chemical formulae. The comparison of MS/MS spectra of the parent compounds and their metabolites allowed to propose chemical structures for possible metabolites in fish bile. With this analytical methodology some metabolites, corresponding to different reactions that includes products of hydroxylation, glucuronide conjugates were identified. The suspect analysis of bile samples allowed the detection of several pharmaceuticals. Psycho-active drugs were one of the most commonly detected drugs. Their identities were proposed by matching their accurate MS and MS/MS data against different libraries. Finally, authentic standards were employed to confirm the proposed drug identities and to determine analyte concentrations in the fish samples.

452 Accumulation and fate of 12 human drugs through the soil-root-leaf system

N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; C. Postigo, IDAE, CID-CSIC / Environmental Chemistry; S. Perez, IDAEA CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry Crop irrigation with reclaimed water has become an extended practice in many countries worldwide where the water scarcity and excessive exploitation of agriculture are forcing local authorities to look for alternative resources. Despite this, the use of reclaimed waters increases local and regional hazardous and endocrine disrupting compounds and contributes to nutrient recycling, using reclaimed water for irrigation, however, represents a primary source of emerging organic contaminants resilient to wastewater treatment processes, such as some pharmaceuticals and personal care products [1]. These pollutants can be retained in the soil, directly uptaken by crops or translocated from soil to plant tissues above the ground [2,3]. The present work aimed to evaluate the transfer and bioaccumulation of organic contaminants of emerging concern (mainly pharmaceuticals) in lettuce tissues and soil. The distribution of twelve relevant wastewater-derived pollutants was evaluated in lettuce tissues (leaves and root system) and soil. This list included nine prescription drugs (diclofenac, trimethoprim, carbamazepine, oxcarbazepine, lamotrigine, cis-diltiazem, valsartan, midazolam, and methadone), an illegal drug (cocaíne) and two transformation products (acridine and valsalart acid). Lettuce plants were grown in pots in a controlled environment and irrigated with artificial spiked water containing the 12 compounds during the entire growing period (60 days). Control was irrigated with tap water. Afterwards, a set of new lettuce plants were grown in the same soil pots and irrigated with rainwater or with tap water, if necessary. At the end of each treatment, leaves, roots and soil were collected for the analysis. A high-resolution mass spectrometry. \(^{14}\)C tracing, enzyme extraction and Illumina sequencing techniques were evaluated a wide range of biological effects in terrestrial organism caused by exposure to CECs. Organisms in these studies included, the cabbage looper (Trichoplusia ni), an earthworm (Eisenia fetida), a model plant (Arabidopsis thaliana) and cucumbers (Cucumis sativus), radishes (Raphanus raphanistrum sativus) and tomatoes (Solanum lycopersicum). These studies have revealed a multitude of effects including increased mortality and development time, reduction in weight, changes to the microbiome and up-regulation of enzymes associated with oxidative stress. Further, the study has highlighted the potential for higher plants to take up, translocate and detoxify CECs.

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season, but still detectable for most of the compounds.

453 Root-uptake and dissipation of atenolol, sulfamethoxazole and carbamazepine applied as a single compound solution or in mixture of all compounds in three soils and five plants
R. Koubek, S. Klement, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Golovko, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocences; M. Fer, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocences; M. Hieker, A. Nikodem, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocences

This study was focused on a root uptake of carbamazepine, atenolol and sulfamethoxazole from 3 soils: Haplic Chernozem, Haplic Cambisol and Arenosol Epitarian. Five plants (radish, arugula, lettuce, spinach and green pea) planted in those soil were initially irrigated by fresh water and next with water contaminated by a single compound or their mixture. After 3 or 4 weeks, each plant was divided into separate parts: roots (including bulbs of radish), leaves, stems (green peas) and pods (green peas). Plant parts and soils were freeze-dried and dry-masses and concentrations of pharmaceuticals and their metabolites were measured. Despite that atenolol and sulfamethoxazole relatively rapidly dissipate from soils, they and metabolites of atenolol were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compounds' transformation depended on a plant family. Considerably higher concentrations of atenolol, sulfamethoxazole and metabolites of atenolol were measured in roots in comparison to those in leaves and soils. In the case of carbamazepine, the highest concentrations were measured in leaves followed by roots and soils. Both indicate a high potential of plants to accumulate studied pharmaceuticals in their bodies and a high ability to transform studied compounds. Particularly in the case of carbamazepine, the considerably higher concentrations of metabolites were measured in leaves in comparison to concentrations in roots and very low or negligible concentrations in soils. Transformation of compounds in plant bodies is attributed to enzymes CYP450. Larger concentrations of carbamazepine metabolites were measured in leaves of lettuce, spinach and green peas than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae). Oxcarbazepine was detected only in plants (n.d. – not detected). The highest type of compound was present in leaves of all tested plants. The impact of application (single compound versus compounds’ mixture) differed for different plants. Antibiotic sulfamethoxazole likely reduced dissipation of other two compounds in soils, which increased relative concentrations of compounds in plants (i.e., concentrations of compound in plant divided by compound loads in soils that is a total amount of applied solute divided by a dry mass of soil).

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (II)

454 Inter-individual variation in the bioavailability and effects of NSAIDs in fish
A. Brown, Exeter University / Biosciences; L. Gunnarsson, University of Exeter / Biosciences; A. Lange; D. Rowe, The University of Exeter; M. Trznadel, University of Exeter / Biosciences; M. Linder-Nording, S. Gouveia, University of Umea; J. Wu, Umea University; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

A basic tenet in the environmental risk assessment of pharmaceuticals is that pharmacological effects will occur in advance of any adverse effects, if their molecular targets are conserved in wildlife and if circulating blood plasma concentrations approach therapeutic concentrations established in humans. Fish generally display high levels of conservation of human drug targets and may be expected to respond to pharmaceuticals via reactions with wastewater treatment plants. The Non-Steroidal Anti-inflammatory Drugs (NSAIDs) ibuprofen and diclofenac are present in effluents, resulting in low mg/L concentrations in surface waters and fish blood plasma below or bordering on "therapeutic" concentrations. However, some studies suggest that diclofenac and ibuprofen can induce harmful effects in fish at measured environmental concentrations. Here we seek to refine the understanding of the biokinetics of NSAIDs by gaining greater understanding of their bioavailability, pharmacologically effective concentrations and inter-individual variations in fish. We quantified plasma prostaglandin (PG) and plasma NSAID concentrations in individual female rainbow trout during and after 12 days continuous flow-through exposures to ibuprofen (0, 10, 200 mg/L) or diclofenac (0, 5, 100 mg/L). High-level NSAID exposures significantly reduced plasma PGE2 concentrations, while low-level exposures were not detectable for ibuprofen or diclofenac. Levels exposures, in part to considerable inter-individual variation in plasma PGE2 levels: 2.6-143 pM for ibuprofen; 0.8-188 pM for diclofenac; versus 0.8-316 pM in control fish. There was no significant correlation between plasma PG and plasma NSAID concentrations within exposure treatments; plasma NSAID concentrations exhibited much lower inter-individual variation, with blood plasma: water partition coefficients ranging from 1-3 for ibuprofen and 1-9 for diclofenac. To identify factors affecting PG levels in individual fish we measured plasma lipid content and plasma protein binding influencing partitioning and bioavailability, haematocrit and potential for reactive protein concentration quantifying baseline immune system status, and plasma cortisol concentrations as a measure of stress in fish, potentially affecting plasma NSAID and PG concentrations. From our analyses, no single factor could explain the observed variations in NSAID uptake and pharmacological response. Our data highlight some of the complexities in interpreting biological exposure and effects data for NSAIDs.

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward
J. Bachmann, German Environment Agency (UBA) / Section IV.2 Environmental Risk Assessment of Pharmaceuticals; S. Schwarz, German Environment Agency UBA / Section IV.2 Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals; I. Rönnefahrt, German Environment Agency - UBA / Section IV.2 Pharmaceuticals

Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/447/04/Rev.2) was adopted in 2006 and is currently under revision. Input has been provided by several stakeholders from academia, industry and government. In this context, the UBA experiences with effect based assessment of human pharmaceuticals will be evaluated and presented. The basis for the evaluation are double quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Both exposure of water protected areas and the data sets are of high quality and anonymous and encoded form. One discussion point will be the question whether the current base of data is sufficient to draw general conclusions. Although the results are based on more than 10 years of experience with environmental risk assessment within the authorization of new human medicinal products, the data basis is still lower than desired. So for some pharmaceutical ingredients detected in surface waters environmental effect data are lacking, because they entered the market before implementation of the EMA guideline. Furthermore, the tailored assessment approach for substances with very specific mode of action will be addressed, especially regarding the remaining uncertainties for protection of biodiversity and the environment. This does apply e.g. for endocrine active substances like contraceptives and anti-cancer drugs. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach replaces long-term exposure data by single compound effect values as applied usually for chemicals without any specific mode of action will be analyzed.
ciprofloxacin, ampicillin, cloclacillin, sulfamethoxazole, trimethoprim and pseudoeuphrinephrine) and 4 ICP ingredients (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thiglycolate and dichlorvos). This is the first attempt to prioritize PPCPs in Nigeria and it provides a useful priority set of chemicals for source water monitoring in the region. Future work will focus on evaluating the results of the prioritisation approach against real world monitoring data for Nigeria.

457 Aquatic toxicity related to pharmacological or secondary targets of human pharmaceuticals
A. Coors, ECT Oekotoxikologie GmbH; A. Falkenhain, C. Brüggemann, ECT Oekotoxikologie GmbH; M. Scheurer, DVGW Water Technology Center / Analysis and Water Quality
Human pharmaceuticals target specific biological structures to exhibit their intended therapeutic effect. The presence of the anticipated biological target of a pharmaceutical in a non-target species may lead to specific effects in that organism, while in the absence of the target non-specific baseline toxicity such as narcosis would prevail. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can also interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explored this hypothesis testing anti-histamines as model substances in Daphnia magna and the green algae Raphidocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative Joint Undertaking under iPiE grant agreement n° 115735, resources of which are composed of financial contribution from the European Union's Seventh Framework Programme (FP7/2007-2013) and EFPIA companies’ in kind contribution.

458 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptomics and biochemical profiles in zebrafish embryos and larvae
C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; A. Haigis, RWTH Aachen University / Institute for Environmental Research RWTH Aachen; R. Hamann, Fraunhofer IME; S. Wuester, Institute for Environmental Research RWTH Aachen; M. Krauss, Helmholtz centre for Environmental Research - UFZ / Department of Environmental Toxicology; A. Hertl, RWTH Aachen University / Institute for Ecosystem Analysis ESA; M. Scheurer, DVGW Water Technology Center / Analysis and Water Quality
Pharmaceuticals are of growing concern as aquatic contaminants due to their extensive use in human medicine. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can also interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explored this hypothesis testing anti-histamines as model substances in Daphnia magna and the green algae Raphidocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative Joint Undertaking under iPiE grant agreement n° 115735, resources of which are composed of financial contribution from the European Union’s Seventh Framework Programme (FP7/2007-2013) and EFPIA companies’ in kind contribution.

459 Virtual fish tales: Liver, Intestinal and Gill Organoids as an in vitro alternative to live fish for prioritising pharmaceuticals and other compounds of highest concern in the environment.
S. Owens, AstraZeneca / Safety Health Environment; L.M. Langan, Plymouth University / Biological and Marine Sciences; R.J. Maunder, Plymouth University / Biological Sciences; M. Baron, Plymouth University; A.N. Jha, Plymouth University / Biological Sciences
Pharmaceuticals enter the aquatic environment largely through patient use, and result in a pseudo- persistent background in the aquatic environment. The risk of these compounds is assessed for new products registered since 1997 where there is a legacy of essential medicines for which we need to understand more. Since, most of the thousand or so pharmaceuticals used by patients are likely to pose little environmental risk, it is important to identify those of most concern in order to prioritise effort and resources; it is vital to be able to predict internal concentrations in aquatic organisms. One method to assess uptake potential is to expose the animals of most concern. However, there are potentially thousands of compounds to be prioritised. Factoring that we already know the uptake rate can be influenced by the concentration of the compound in the water, there are enormous ethical implications for conducting this work with live animals (fish), and significant cost of resources to practically conduct the work. Alternatives are clearly required. Significant efforts to better predict environmental exposure are underway as part of the iPiE project (IM grant no. 115735—iPiE). In silico methods provide a first tier of screening, but we are likely still faced with hundreds of compounds to assess at multiple concentrations. We have been developing in vitro tissue micro-organs (organoids) that replicate the in vivo tissue. These can be used to build a virtual fish that will allow the screening of pharmaceuticals (or other compounds of concern or even metals) without testing live fish (BBSCR/NERRC grant BB/L01016X/1). By building fish tissue cultures that better represent the complexity of the in vivo situation, we are able to offer in vitro models that can simulate live fish. Water exposure to the gill model can now be tolerated (without compromise) for several weeks, intestinal models are similarly robust. Since both methods employ a permeable barrier culture, rates of flux can be measured that provide not only simple information such as a compound may be taken up, but also rates of uptake and excretion. These data can be used to build kinetic models. The liver spheroids provide a metabolic tissue that when used in co-culture with the gut or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.

Emergence and multidimensional interactions of engineered nanoparticles in toxicity
460 Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations
S. Sforzini, Universita Del Piemonte Orientale Amedeo Avogadro / Department of Sciences and Technological Innovation (DiSIT); C. Oliveri, Universiti di Piemonte Orientale / Department of Sciences and Technological Innovation DiSIT; A. Barranger, University of Plymouth / School of Biological Sciences; J. W. Readman, University of Plymouth / Biochemistry Research Centre; Y. Aminot, University of Plymouth; A.N. Jha, Plymouth University / Biological Sciences; M. Banni, Laboratory of Biochemical and Environmental Toxicology; A. Viarengo, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Laboratory of Environmental Chemistry and Toxicology
Little is known about the effects at cellular, tissue and individual levels of emergent contaminants such as fullerene C60 and other nanomaterials. In this study, we evaluated the effects of C60 on mTOR (mechanistic Target of Rapamycin) activity in mussel digestive gland were studied. mTOR is an evolutionarily-conserved serine/threonine protein kinase that senses and integrates a variety of cellular physiological and environmental signals to regulate cell growth. mTOR is found in two functionally distinct complexes, mTORC1 and mTORC2. In particular, the phosphorylated active form of mTORC1 mediates temporal control of cell growth by activating anabolic processes (such as transcription, ribosome biogenesis, protein synthesis), and by inhibiting catabolic processes (such as autophagy); mTORC2 is primarily involved in the function of DEGs showing a bell shape trend in vivo. We evaluated the presence and cellular distribution of C60 in mussel tissues, already at the lowest concentration. Our data demonstrated that the changes of the phosphorylation of mTORC1 and mTORC2 may explain most of C60 effects studied at cellular and tissue level. Indeed, the C60 induced dephosphorylation of mTORC1 contributed to increase autophagy and to decrease protein synthesis as well as the reduction of lysosomal membrane stability and the enhancement of lysosomal/cytosolic volume ratio of the digestive gland cells; and mTORC2 to affect cytoskeleton organisation as revealed by the changes of actin/tubulin structures. Transcriptomic data are important to understand the cellular adaptive responses to the chemical. For this purpose, a novel low density oligo microarray (470 genes, suitable to follow 15 stress response pathways) was used. Transcriptomic analysis identified a number of DEGs showing a bell-shape trend with a maximum in animals exposed to 0.1 mg/L C60. In terms of processes related to the DEGs depicted in all conditions, the most affected are associated to...
translation, cytoskeleton organization and mitochondrial activity. Transcription of selected genes was verified by RT-qPCR. These represent the first data on C50 tissue subcellular distribution and on the possible involvement of mTOR in the physiological alterations due to nanoparticle accumulation.

461 Protemic responses to nanoparticle and ionic silver in freshwater microbes with different background
D. Barroso, Universidade do Minho / Centre of Molecular and Environmental Biology, Department of Biology; A. Pradhan, University of Minho / Department of Biology; P.M. Santos, C. Pascual, F. Cassio, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology. Enhanced use of silica nanoparticles (SNPs) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional proteomics is an emerging technology that provides high-throughput analyses augmenting measurements of direct and highly sensitive responses at the cellular and sub-cellular levels. The impacts of AgNPs and ionic Ag at EC50 (effective concentration) were assessed based on the variations in the overall proteome in 2 aquatic fungal strains of Articulospora tetracladia, one isolated from a non-polluted stream (At72) and the other from a metal-polluted stream (At61), and ii) the bacterial strain Pseudomonas sp. M1 (PsM1) isolated from a metal-polluted stream. At72 was the most sensitive to AgNPs, whereas PsM1 was the most tolerant one. Characterization of AgNPs showed increased particle stability and lesser agglomeration with time in At72 while for At61 and PsM1 there was an increase in AgNPs agglomeration explaining its lower impacts on their growth. In fungi, ~40% of the total quantified proteins were significantly altered after exposure to AgNPs and/or Ag+ whereas for PsM1 this percentage was lower (~20%). At72 and At61 shared only 20% of the proteins suggesting that the biological pathways involved in Ag+ and AgNPs exposure were different. At61 had ~25% more proteins induced by both Ag forms (compared to At72), suggesting higher response which is consistent with the background of this fungal strain. In PsM1, 32% of the proteins increased under exposure to AgNPs whereas the percentage for Ag+ was higher (68%) indicating different responses to Ag+ and/or AgNPs. In At72, Ag+ increased the content of proteins involved in protein homeostasis while AgNPs increased the content of proteins related to DNA repair, the transport of substances and energy production. In At61, AgNPs increased the content of proteins involved in protein synthesis and energy production while both forms of Ag increased the content of proteins related to cell-redox and protein homeostasis, biomass and spores production and also to nucleic acids metabolism. Both Ag forms induced stress-responsive proteins which was consistent with the responses of enzymes involved in oxidative stress. Overall, functional proteomics can be useful to get a mechanistic insight on the stress induced by AgNPs and/or Ag+ in microbes that play key roles in freshwater ecosystems.

462 Hazard assessment of seven different commercial silica nanoparticles on a battery of test species: bacteria, algae and fish cell lines
E. Griskunas, University of Rhode Island, Department of Biology; C. J. Lawlor, University of Rhode Island / Department of Marine Sciences; J. Surve, Goteborg University / Department of Biological and Environmental sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences. Manufactured silica nanomaterials are widely used in numerous applications in society such as paints, coatings, cosmetics, textiles and food and its release into the environment is of concern. There is a growing concern regarding the risk of silica nanomaterials and was in 2010 selected as one of the priority substances by the OECD Working Party on Manufactured Nanomaterials. In order to thoroughly examine the toxicity of silica nanomaterials to deuterants, primary producers and fish, a panel of seven well characterized (with different size, coating and charge), biodegradable, silica nanomaterials, were tested on bacteria, algae and fish cell lines. Based on the result, the current study also examined the selection of an appropriate exposure metric comparing mass (mg/L), number of particles (No/L) and surface area (m²/L) against the observed toxicity. The results show that gill cell lines were the most sensitive test model with the lowest reported EC20 value of 5.1mg/L after exposure to the smallest particle at a concentration range of 12.5-100mg/L. Toxicity to fish cells was determined to be surface dependent, except for particles coated with ethoxy silane, which did not show any toxicity. For bacteria and algae, the cell wall seems to play a major role in the uptake and toxicity of silica nanoparticles. Keywords: hazard assessment, silica nanoparticles.

463 Toxicity Assessment of Engineered Titanium Dioxide Nanoparticles
S. Bitragunta, Birla Institute of Technology & Science Pilani,Hyderabad Campus / Biological Sciences; S. Palani, Birla Institute of Technology & Science,Hyderabad Campus / Biological Sciences. Titanium dioxide engineered nanoparticles (TiO2-ENP) are extensively employed in manufacturing of cosmetics, pharmaceuticals and health care products. As a result, TiO2-ENP can reach the ultimate sink such as soil in the environment during their life cycle. In this context, investigations to understand environmental implications of nanoparticles including TiO2-ENP are gaining prominence across the globe. In the backdrop of assessment toxicity of rutile TiO2-ENP (r-TiO2-ENP) in soil samples, present study is aimed at evaluating their toxicity as per OECD-207 guidelines on earthworm, Eisenia fetida. Physicochemical characterization of r-TiO2-ENP using dynamic light scattering revealed their tendency to form agglomerates (330-480 d.nm) in water. Soil exposure of earthworms to r-TiO2-ENP (0.1, 0.15, 0.2 and 0.25 mg/kg) showed no mortality after 48 h. Increased specific activities of antioxidant enzymes including catalase, sucrase, dehydrogenase and glucose oxidase along with lipid peroxidation indicate the potential of r-TiO2-ENP to induce oxidative stress in the sentinel organism. Interpretations of the study can serve as cues to design a comprehensive approach for developing invertebrate based biomarkers and indicators as early warnings for assessing environment and health impacts of engineered nanoparticles.

464 Combination effects of chlorpyriphos and ZnO on oxidative stress and reproduction of the earthworm Dendrobaena veneta
D. Hackenberg, Department of Biology, University of Osijek / Department of Biology; L. Lominac, University of Osijek / Department of Biology; D. MarkovidŽ, University of Rijeka / Department of Biotechnology. The four (TAPAS) Tools for Assessment and Planning of Aquaculture Sustainability (TAPAS) Poster spotlight: WE305, WE323, WE324

Improving the environmental risk assessment of the aquaculture 'Blue Revolution'

465 Poster spotlight: WE305, WE323, WE324

466 Tools for Assessment and Planning of Aquaculture Sustainability (TAPAS)
P. van den Brink, Alterra and Wageningen University; A. Lillicrap, NIVA Norwegian Institute for Water Research / Ecotoxicology; A.L. Macken, Norwegian Institute for Water Research / Ecotoxicology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T.C. Telfer, University of Stirling Aquaculture is a major food production subsector in microbes that play key roles in freshwater ecosystems. As a result, enhanced use of silver nanoparticles (AgNPs) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional proteomics is an emerging technology that provides high-throughput analyses augmenting measurements of direct and highly sensitive responses at the cellular and sub-cellular levels. The impacts of AgNPs and ionic Ag at EC50 (effective concentration) were assessed based on the variations in the overall proteome in 2 aquatic fungal strains of Articulospora tetracladia, one isolated from a non-polluted stream (At72) and the other from a metal-polluted stream (At61), and ii) the bacterial strain Pseudomonas sp. M1 (PsM1) isolated from a metal-polluted stream. At72 was the most sensitive to AgNPs, whereas PsM1 was the most tolerant one. Characterization of AgNPs showed increased particle stability and lesser agglomeration with time in At72 while for At61 and PsM1 there was an increase in AgNPs agglomeration explaining its lower impacts on their growth. In fungi, ~40% of the total quantified proteins were significantly altered after exposure to AgNPs and/or Ag+ whereas for PsM1 this percentage was lower (~20%). At72 and At61 shared only 20% of the proteins suggesting that the biological pathways involved in Ag+ and AgNPs exposure were different. At61 had ~25% more proteins induced by both Ag forms (compared to At72), suggesting higher response which is consistent with the background of this fungal strain. In PsM1, 32% of the proteins increased under exposure to AgNPs whereas the percentage for Ag+ was higher (68%) indicating different responses to Ag+ and/or AgNPs. In At72, Ag+ increased the content of proteins involved in protein homeostasis while AgNPs increased the content of proteins related to DNA repair, the transport of substances and energy production. In At61, AgNPs increased the content of proteins involved in protein synthesis and energy production while both forms of Ag increased the content of proteins related to cell-redox and protein homeostasis, biomass and spores production and also to nucleic acids metabolism. Both Ag forms induced stress-responsive proteins which was consistent with the responses of enzymes involved in oxidative stress. Overall, functional proteomics can be useful to get a mechanistic insight on the stress induced by AgNPs and/or Ag+ in microbes that play key roles in freshwater ecosystems.

Improving the environmental risk assessment of the aquaculture 'Blue Revolution'
aquaculture by developing tools, approaches and frameworks to support EU Member States in establishing a coherent and efficient regulatory framework, implementing the Strategic Guidelines for the sustainable development of European aquaculture and delivering a technology and decision framework for sustainable growth. The ultimate goal of the project is to create cost-efficient management tools and practices for the European aquaculture sector to investigate the scope of fish farming activity, social interactions, potential environmental impacts and any future risks.

467 Preliminary investigation on the occurrence of multifunctional organic micropollutants in offshore seawater and fish farm

Lou, N. National University of Singapore; Cin, National University of Singapore / Civil & Environmental Engineering

Limited research has been conducted on the occurrence and distribution of antibiotics, pharmaceuticals, personal care products, endocrine disrupting chemicals and artificial sweeteners in the marine environment despite being increasingly impacted by these micropollutants (MPs). In this study, the presence and distribution of multifunctional organic micropollutants in 14 different groups were investigated in offshore seawaters and fish farms of Singapore. The sampling area is affected by various anthropogenic pressures including treated effluents, fish farming, shipping and port activities. A total of 23 MPs were found in offshore seawaters, 9 of them with detection frequencies higher than 50%. The highest detected values corresponded to cyclamate, salicylic acid and sucralose, with concentration range of 50000 – 540000 ng/g.

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality

B. Brooks, Baylor University / Dept of Environmental Science; J.L. Conkle, Texas A&M University Corpus Christi / Physical and Environmental Sciences

By 2050, it is estimated that global food production must increase by 50%. Aquaculture will play an important role to meet these needs. For example, in 2014 aquaculture surpassed global fisheries in providing fish for human consumption. It is important to note that global aquaculture activities can impact not only urban regions but rural areas as well, further contributing to urbanization. Yet high population increases in urbanizing regions result in concentration of food, energy, water and other resource consumption. Urbanization also leads to concentration of chemical use, which inherently results in exposures to human populations and ecosystems receiving waste streams within and from these urban centers. In developing nations, where many of the megacities will continue to emerge over the next few decades, aquatic systems are occurring faster than public health interventions and environmental management systems are being implemented. Unfortunately, 80% of the global sewage production is not treated, but returned to the environment and thus reused for various purposes. These non-traditional reused waters are being recycled for agriculture, including aquaculture in areas experiencing rapid urbanization, yet implications for water security, food safety and international trade are not routinely examined to manage more sustainable aquaculture practices. In the current presentation we draw from our ongoing efforts in Asia and North America to understand bioaccumulation of organic contaminants of emerging concern in common fish and shellfish used for aquaculture. For example, we have observed aquacultured bivalves to accumulate diverse contaminants of concern (e.g., pharmaceuticals, pesticides, flame retardants), apparently from landfill leachates and discharges of marginal quality, in Hong Kong. Our findings from laboratory uptake and depuration studies with channel catfish and tilapia focus on contaminants with diverse physico-chemical properties (e.g., weak base medicine, phosphorus-based flame retardant, perfluorinated compound, cyanotoxin) and provide an approach to improve aquaculture practice and to support bioaccumulation assessments for chemicals falling outside of applicability of non-target species. In North America we are examining intersections among water reuse and aquaculture practices for various products. Such efforts appear warranted at the global scale.

469 Bioaccumulation of selected veterinary medicines in the blue mussel (Mytilus edulis)

S. Brooks, NIVA / Ecotoxicology and Risk Assessment; B. Beylich, NIVA; A. Ruus, NIVA / NIVA; J. Rundenberget, NIVA; A. Lilliecrap, NIVA / Ecotoxicology and Risk Assessment

Veterinary medicines are widely used within the fish farming industry for the control of sea lice infestation. In 2016, over 10 tonnes of veterinary medicines were used by Norwegian fish farms for the control of sea lice. The impact on non-target species has raised increasing concern. For instance, do wild and farmed mussels in the vicinity to these fish farms have the potential to bioaccumulate these chemicals and thereby pose a threat to human health? On the other hand, mussels may be the most suitable biomonitoring species for the presence of veterinary medicines in the environment. To better understand these scenarios, and the fate of these chemicals in the environment, a series of laboratory controlled exposures were performed to determine the bioaccumulation and depuration of selected veterinary medicines in the blue mussel (Mytilus edulis). The veterinary medicines included telfubenzuron, emamectin, deltamethrin and azamethiphos. Due to the low solubility of telfubenzuron and deltamethrin a saturation column was employed within a flow-through system to deliver a stable concentration of test chemical over a 14-day uptake phase. Water and mussel samples were collected at time intervals during the 14-day uptake phase, and again following transfer of the mussels into clean flowing seawater during the 7 to 14 day depuration phase. The effects of salinity on the bioaccumulation of telfubenzuron also indicated that lower mussels in brackish waters show different bioaccumulation dynamics. So far, we have shown a clear uptake of telfubenzuron over 14 days, reaching maximum concentrations (~1500 ng/g) after 10 days. Depuration of telfubenzuron was fast for the first 2 days, although still present at approximately 250 ng/g after 7 days depuration. Salinity had no apparent effect on the bioaccumulation of telfubenzuron. In contrast, emamectin showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of emamectin was observed after 7 days in clean flowing seawater. The results suggest that mussels are a suitable biomonitoring species for the presence of veterinary medicines in the environment. Additionally, mussel farms in close proximity to fish farms have the potential to bioaccumulate these chemicals in their tissues and is subsequently recommended for monitoring.
Systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (II)

472 Systems toxicology approach for the assessment of zebrafish cardiac and neurotoxicity

A major goal in the field of toxicology is to predict long term animal health risks and/or environmental hazards associated with a particular substance(s).

Traditionally utilised classical toxicology methods involve animal exposure over a relatively short period and recording adverse outcomes. These data are then extrapolated to human effects and to other species. The accuracy of such extrapolation would benefit from mechanistic understanding of toxicity. However, molecular basis for adverse outcomes is not easily interpreted from classical toxicology methods. Here we present our systems toxicology approach that focuses on deciphering biological mechanisms responsible for adverse outcomes. The underlying structure of this approach is a computable biological network model. We have developed two models describing molecular pathways that lead to cardio toxicity and neurotoxicity in zebrafish larvae based on the knowledge curated from scientific literature. Key signalling nodes in the model are linked to information about downstream gene expression. Differential expression of downstream genes can be used to infer activity of the upstream protein – a process termed network scoring. Scoring of the network highlights the most affected nodes, which leads to mechanistic hypothesis generation and gives a quantifiable measure of network perturbation. In parallel to network scoring, we utilize classical toxicology methods to detect adverse outcomes. We present the acute toxicity results for selected chemicals (e.g. acrylamide, arsenic, clenbuterol, imidacloprid) according to the OECD fish embryo acute toxicity test (OECD test guideline 236). We then report results from chemically exposed larvae in functional cardiac and behavioural assays, and transcriptomics analyses. Finally, we describe the utility of the network model in interpreting transcriptomics analyses to gain mechanistic insight into the molecular events initiated by a given chemical. Cardiac and neural apical endpoints together with computational network scoring provide a comprehensive method for linking molecular events to organ toxicity. This approach will enable more accurate toxicity predictions over long exposures and in different species.

473 Time response relationship between gene expression and life history in a Daphnia population exposed to heavy metals
I. Asselman, J. Sembour. Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology GhEnToxLab unit, K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Over the last decade, molecular technologies have evolved into robust high throughput platforms available to many scientists in a wide variety of disciplines. Implementation of these technologies in ecotoxicology and risk assessments have focused on mechanisms of toxicity and stress response on the gene level to explain effects at the organism level. However, current studies remain focused at the individual level and rarely include population level molecular responses. Population level molecular responses may provide a better insight into the potential mechanisms at play at the population level while at the same time avoid focusing on gene expression patterns that are the cause of clonal or interindividual variation. Furthermore, most studies select an arbitrary timepoint and measure gene expression responses without any prior knowledge. Here, we focus on population level responses of a Daphnia magna population to arsenic and copper and their binary mixture. The population was exposed to low chronic toxicity concentrations of arsenic and copper resulting primarily in effects on reproduction rather than survival. Rather than focusing on a single arbitrary timepoint, gene expression data and life history data were both recorded at multiple time points. As such, these datasets will provide a first basis on how exposure duration may affect the conclusions and decisions made about the toxicity of chemicals. In addition, by collecting both molecular data and life history data, we will be able to better understand the time response relationship in populations under stress both at the life history level and the molecular level. This will allow us to better integrate these two data types and identify potential causal relationships between the molecular level and the life history level. The identification of such causal relationships will play an integral part of incorporating omics data in environmental risk assessment.

474 How to implement functional responses of microalgae in risk assessment processing?
E. Jansen, Helmholtz Center for Environmental Research - UFZ GmbH; E. Biller, Universität de Lorraine, CNRS UMR 7360; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; M. Delinette-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionary Biology; M. Schmitt-Jansen, UFZ - Helmholtz Cte Environm. Research / Department of Bioanalytical Ecotoxicology

Microorganisms (e.g. bacteria, fungi and algae) are involved in various ecosystem functions such as biogeochemical cycles or pollutants degradation meaning that they are crucial for ecosystem functioning. In the environment, organisms are exposed to anthropogenic pressures which are known to potentially induce structural and functional changes. If such causal links are identified, little is known about the involved biochemical pathways supporting specific functions. Moreover, most of a priori ecological risk assessment (ERA) tools are based on structural endpoints and do not necessarily ensure the protection of these functions. The recent raise of OMICs approaches (e.g. transcriptomics and metabolomics) opens the perspective in ecotoxicology to explore pathways involved in ecological functions. The main aim of this study was to provide a new and innovative risk assessment tool based on functional responses (captured via OMICS approaches) of the most ecologically relevant and toxicologically sensitive species. The rationale to use OMICs in such context is to provide more protective and early warning thresholds. The transcriptomic and the metabolomic responses of Scenedesmus vacuolatus to triclosan were explored after exposure of 14 hours along an increasing gradient of 5 concentrations (from 0.69 to 6.63 µg/L, 5 replicates). Within a dedicated workflow, we selected the responsive molecular signatures/pathways/tissues, we built concentration responses curves for each of them and we derived a sensitivity value from each curve (even the non-monotonic one). Molecular items showed mainly non-sigmoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. The two molecular items were linked (when possible) to the pathways they are involved in. From that information, we built a SSD-like tool based on functional responses captured at the community level in order to protect functions and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

475 Sex, drugs and Daphnia magna. A multi-omics approach suggests conserved mechanisms of interaction between metallohormones and endocrine disruptors
E. Carman-Gutierrez, University of Liverpool / Computational Biology Facility; P. Arthur. University of Liverpool / Institute of Integrative Biology; L. Rahai, The University of Birmingham / School of Biosciences; K. Gruntzalis, The University of Birmingham; M.R. Viant, University of Birmingham / School of Biosciences; F. Falciani, University of Liverpool / Institute of Integrative Biology

The assessment of environmental exposure to toxic chemicals released by human activity as well as their impact on biological systems is key to protect the biosphere. Current ecotoxicological approaches and protocols are based on chemical analysis and assessment of biodiversity. Although this has been a very effective strategy, it has some shortcomings. These include the fact that a relatively limited number of compounds can be measured and linked to biologically relevant organism-level responses. The issue is particularly challenging in chronic exposures and in complex mixtures scenarios. This project aims at identifying the molecular networks linked to single and mixture exposures and to use these to infer the effects of chemical mixtures. We approached this important challenge by applying a systems biology approach to integrate expression profiling, metabolomics and phenotypic data (respiration and feeding rates), representing the response of Daphnia magna to a panel of environmentally relevant chemicals and their mixtures. Firstly, it was exposed to a battery of single compounds with known mode of action (MoA) i.e. estrogen disruptors and acetylcholine esterase (AChE) inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within Daphnia. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either endocrine disruptors or AChE inhibitors. Cadmium (Cd), which clustered with endocrine disruptors or AChE inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within Daphnia. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either endocrine disruptors or AChE inhibitors. Cadmium (Cd), which clustered with endocrine disruptors or AChE inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within Daphnia. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either endocrine disruptors or AChE inhibitors. Cadmium (Cd), which clustered with endocrine disruptors or AChE inhibitors. The study was to provide a new and innovative risk assessment tool based on functional responses (captured via OMICS approaches) of the most ecologically relevant and toxicologically sensitive species. The rationale to use OMICs in such context is to provide more protective and early warning thresholds. The transcriptomic and the metabolomic responses of Scenedesmus vacuolatus to triclosan were explored after exposure of 14 hours along an increasing gradient of 5 concentrations (from 0.69 to 6.63 µg/L, 5 replicates). Within a dedicated workflow, we selected the responsive molecular signatures/pathways/tissues, we built concentration responses curves for each of them and we derived a sensitivity value from each curve (even the non-monotonic one). Molecular items showed mainly non-sigmoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. The two molecular items were linked (when possible) to the pathways they are involved in. From that information, we built a SSD-like tool based on functional responses captured at the community level in order to protect functions and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

Overall, our work shows that it is possible to predict a compound MoA from its systemic responses without any prior knowledge. Rather than focusing on a single arbitrary timepoint, gene expression data and life history data were both recorded at multiple time points. As such, these datasets will provide a first basis on how exposure duration may affect the conclusions and decisions made about the toxicity of chemicals. In addition, by collecting both molecular data and life history data, we will be able to better understand the time response relationship in populations under stress both at the life history level and the molecular level. This will allow us to better integrate these two data types and identify potential causal relationships between the molecular level and the life history level. The identification of such causal relationships will play an integral part of incorporating omics data in environmental risk assessment.
molecular state and also predict additive or synergistic effects of mixture exposure.

476 Data-driven systems biology approach gives insight into a complex process of water remediation
J. Kronberg-Guzman, The University of Birmingham / School of Biosciences; T.D. Williams, University of Birmingham / School of Biosciences; A. Mark, Wageningen Agricultural University / Dept of Toxicology; E. Foeckema, Wageningen IMARES; R. van der Oost, Waternet / Onderzoek en Advies; K. Chipman, University of Birmingham; F. Falciiani, University of Liverpool / Institute of Integrative Biology

Introduction. Increasing population and industrial production put strain on clean water resources. Even in highly developed countries with advanced waste water treatment plants, water quality could be improved further before releasing it. Constructed wetlands have been used for water treatment for decades and are a low-cost natural option. Waterhyacinth is an example of such additional treatment, consisting of a sedimentation pond, reed bed and a wetland forest. In this work, we have used three-spined stickleback living in mesocosms containing water from various stages of additional remediation from three different sites in the Netherlands. Aim. The aim of this work was to understand the effects of additional steps of water remediation. Results. We have used a data-driven systems biology approach to understand the relationship between the environment (chemical concentrations), molecular high-throughput measurements (stickleback liver gene expression), physiological parameters and more traditional measures of toxicity. We first integrated all different measurements into static similarity networks and modularised these so that in each module, genes are responding in a similar way during different stages of remediation. We see that some chemicals with high chemical risk (aldicarb, chlorpyriphos, fluoranthene, pirimiphos methyl) decrease in all sites and are also correlated with gene expression in both male and female stickleback. However, some chemicals are only correlated with gene expression in one of the sexes of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCBs and mineral oils) are associated with modules containing several high-risk chemicals. Functional annotation reveals further insights. For example a module of the male stickleback network correlated with liver weight and several chemicals including triclosan and phthalates has a statistically significant number of genes from the KEGG pathway „metabolism of xenobiotics by cytochrome P450“. However, a module in the male-specific network that is not correlated with any chemicals, is enriched in KEGG functions related to immune functions („antigen processing and presentation“, „type I diabetes mellitus“ and „cytokine-cytokine receptor interaction“). Conclusion. We have showed the potential of data-driven systems biology approach integrating various types of data to give insight into the effects of a complex remediation system.

477 Co-expression network analysis of massive proteogenomic data: applications in ecotoxicology.
D. Deligiannis; Post; Istrea / UR RIVERLY Laboratoire Ecotoxicologie; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, Istrea Lyon / UR MALY Laboratoire Ecotoxicologie; J. Trapp, Istrea Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systèmes Perturbés; O. Pible, CEA; a. chaumot, O. Geffard, Istrea / UR MALY Laboratoire Ecotoxicologie; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics

Data mining of biological and omics data in test species under contaminant exposure promises the possibility to gain insights into the mode of action of chemical compounds and molecular pathways involved in toxic responses. Intuitive network concepts (e.g. connectivity and modularity) have been found useful for analyzing complex interactions and successfully applied to study gene-gene and protein-protein interactions. Currently, a majority of protein networks are constructed using protein-protein interaction (PPI) databases. However, manually curated PPI databases are typically heterogeneous, documented for few model species, and often characterized by incomplete coverage, and selection or detection biases. De novo (or a priori) approaches based on observed data offer an alternative under which prior knowledge of protein interaction is not necessary but rather advantageously replaced by direct measurements and pair-wise correlation analysis of their abundance. This approach may be particularly powerful to identify signaling pathways which proteins with unknown function belong to or to identify novel, pertinent biomarkers of toxicant exposure. Here we present a network analysis method applied to shotgun high-throughput proteomic data we produced for the aquatic sentinel organism Gammarus fossarum. Shotgun proteomics was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to insecticides potentially inducing endocrine disruption in this crustacean. We identified protein modules significantly associated to morphologically well-characterized physiological states and to pesticide exposure. Moreover, the identification of crucial hub proteins could allow proposing exposure-related or toxicological functional biomarkers. This new data mining procedure opens interesting perspectives for the development of a novel generation of molecular diagnostic biomarkers in ecotoxicology.

Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (I)

478 How researchers can work in alliance with citizens to fight misinformation and improve public debates
S. Vanhoutte, Sense About Science EU

Public resistance against glyphosate, GMOs, animal testing, vaccination and numerous other scientific innovations has made many scientists defensive and paranoid about the public. Recent discussion about a post-truth society and anti-intellectualism have increased this perception of a hostile and ignorant public. With concrete examples, Sofie will illustrate a different, more effective approach for both researchers and non-researchers to bring back reason into emotional debates. This approach, called public expert-fact – in which scientists respond directly to real, unedited questions from the public – breaks through polarised and difficult debates because conversation is led by the questions and issues people raise. It allows researchers to identify gaps and misunderstandings in the public debate and to respond to them. With this approach, rather than fighting the public resistance against new technologies, researchers can work in an alliance with citizens to fight misinformation and improve the public debates.

479 Discussion: the need to promote good science and evidence in public debates

480 How to communicate the risks posed by endocrine disrupting chemicals? (I)
J. Legler, Utrecht University / Institute for Environmental Studies

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

481 How to communicate the risks posed by endocrine disrupting chemicals? (II)
M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

482 Discussion Endocrine Disrupting Chemicals

483 A regulator’s perspective in involving stakeholders and the public in the regulation of a substance
C. Ajan, ECHA-European Chemicals Agency; W. de Wolf, ECHA / Product Safety & Regulatory Compliance

The European Chemicals Agency (ECHA) was established in June 2007 through
the REACH Regulation, and the registration of all substances already on the market above 1 ton per annum will be completed in 2018. Since its start the areas of responsibility expanded from industrial chemicals to biocides, capturing as well the communication of chemical hazards to workers and the public through the Classification, Labelling and Packaging Regulation (CLP), and the regulation of international trade of hazardous chemicals. The latter includes support for the protection of human health and the environment by providing developing countries with information on how to store, transport, use and dispose of hazardous chemicals safely through the Prior Informed Consent Regulation (PIC). Unl its decision making and opinion forming, ECHA uses the scientific information provided by academia and industry and applies them within the regulatory framework that it operates. Transparency is one of the values that is driving ECHA in its interactions with its different stakeholders, and the ECHA Scientific Committees invite ECHA’s accredited stakeholders as regular observers and contributors to its meetings. UnThis presentation will look at regulatory science communication by describing the different stakeholders that ECHA interacts with, the forms of communication used and their timeframes. It will also explain the regulatory boundaries ECHA has to abide to, which influence the uptake of the latest science developments, and their communication with a special focus on the decision making and opinion forming at the Member State Committee. DISCLAIMER: ‘The views expressed in this abstract are solely those of the authors and the content of the paper does not represent the views or position of the European Chemicals Agency’.

484 Questions/Discussion

485 General Discussion with panel of Sofie Vanthournout, Juliette Legler and Markus Hecker

486 Concluding remarks part I and a teaser for part II!

487 The impact of chemical pollution on the resilience of soils under multiple stressors

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturation and elongation transcriptions in fathead minnow

489 The effect of water chemistry on cadmium induced olfactory impairment in juvenile rainbow trout (Oncorhynchus mykiss)

EcoLOGICAL risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (III)

System regime after occurrence of further stress. We highlight this issue by compiling the literature exemplarily for the effects of Cu contamination and compaction on soil functions and structure. However, examples of further co-occurring stress scenarios will be described as well. In this discussion paper, we propose to intensify research on effects of combined stresses involving a multidisciplinary team of experts and provide suggestions for corresponding experiments. Our concept offers thus a framework for system level analysis of soils paving the way to enhance ecological theory.

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturation and elongation transcriptions in fathead minnow

M. Fadhlaoui, INRS - Eau, Terre et Environnement / Centre Eau Terre Environnement; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; P. Couture, INRS / Centre Eau Terre Environnement

In this project, two freshwater fish commonly found in areas affected by metal contamination were acclimated to different temperatures (9 and 28°C for yellow perch (Perca flavescens) and 15, 25 and 30°C for fathead minnow (Pimephales promelas)) and exposed either to Cd or Ni during 8 weeks. At the end of exposures, we measured cell membrane phospholipid fatty acid composition, the activities of superoxide dismutase, catalase, glutathione-S-transferase, glutathione peroxidase (enzyme indicators of antioxidant capacities), the concentrations of glutathione (antioxidant) and malondialdehyde (indicator of lipid peroxidation (LPO)) as well as the transcription levels of desaturases (fas2, des2, scd2) and elongases (elov2, elov5, elov6). Both yellow perch and fathead minnow counteracted the effects of changes in acclimation temperature on cell membrane properties by remodelling their phospholipid fatty acid composition. Specifically, in the muscle of both species, polyunsaturated fatty acids increased in cold-acclimated fish compared to warm-acclimated fish, in agreement with the theory of homeoviscous adaptation. However, in brain cell membrane composition was more conservative, especially in fathead minnows. Polyunsaturated fatty acids are more vulnerable to LPO than saturated fatty acids and metal contamination leads to oxidative stress. We therefore tested the hypothesis that temperature-induced changes in cell membrane polyunsaturation are accompanied by variations in LPO in metal-exposed fish.

Unspecifically, in both species, metal exposure itself affected membrane fatty acid composition. In yellow perch, the normal response of cell membrane composition to thermal acclimation was reversed by exposure to both metals. Yet, in spite of the high polyunsaturation level in warm-acclimated fish under Ni exposure, MDA concentration was the lowest, suggesting a massive response of the antioxidant system to fight against LPO. In fathead minnow, metal exposure also affected the membrane fatty acid composition of both tissues, but the response was stronger for yellow perch. We observed a mismatch between desaturation and elongation gene transcription and membrane composition. Overall, our results suggest that levels of control of cell membrane fatty acid composition other than gene transcription may be affected by temperature and metal exposure, such as post-transcriptional regulation of gene transcription and de novo phospholipid biosynthesis.

489 The effect of water chemistry on cadmium induced olfactory impairment in juvenile rainbow trout (Oncorhynchus mykiss)

S. Volz, RWTH Aachen University / Department of Ecosystem Analysis; S. Bogart, A. Macdonald Wilson, University of Lethbridge / Department of Biological Sciences; H. Hollett, RWTH Aachen University / Institute for Environmental Chemistry; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; G.G. Pyle, University of Lethbridge / Biological Sciences

Fish are dependent on olfaction since a variety of essential behaviors, such as foraging, predator avoidance and mate selection, are mediated by the olfactory system. Metals are well known to affect the olfactory system of fishes at environmentally-relevant concentrations. As metal toxicity varies with water chemistry in a predictable manner, modelling approaches, such as the Biotic Ligand Model (BLM), are powerful tools to predict site-specific effect concentrations. To date, the BLM used in risk assessment for fish only predicts gill-based metal toxicity. However, metal-binding dynamics at the olfactory epithelium may be different than for gills. For this reason, the present study investigated the impact of water chemistry on cadmium induced olfactory impairment. In order to assess the effect of Cd on the olfactory system, fish were exposed to 45–720 µg/L Cd for 24 h. Subsequently, olfactory responses to two odors were measured via electro-olfactography (EOG). To investigate the impact of water chemistry on Cd-induced olfactory impairment, fish were exposed to the EOG-based 24-h IC50 of Cd (210 µg/L) in reconstituted water with varying hardness, pH, and dissolved organic carbon (DOC). Conclusions for 24 h Cd inhibited the EOG response of rainbow trout in a concentration dependent manner. Fish exposed to 210 µg/L Cd for 24 h showed reduced olfactory response to TCA by 50%. Changes in water chemistry had a significant impact on Cd-induced olfactory impairment. Decreasing water hardness from 130 to 40 mg/L as CaCO3 increased the inhibitory effect of Cd on the EOG response from 55% to more than 95%, respectively. Hence, hardness ameliorates Cd-induced olfactory impairment. By contrast, Cd-induced olfactory impairment increased with rising pH, which may be due to a difference in metal speciation. DOC had a protective effect against Cd-induced olfactory impairment, likely by forming complexes with Cd ions and reducing their
bioavailability. In conclusion, water chemistry is an important modulator of metal toxicity, not only for acute lethality but also for sub-lethal effects, such as olfactory impairment. In order to enable the prediction of site-specific olfactory toxicity, the development of a BLM parametrized to the olfactory system of fish would be very beneficial. However, more data on the effect of water chemistry on metal-induced olfactory impairment is required to be able to determine affinities constants and maximal binding capacities.

490 Physiological and biochemical responses of polychaetes: interplay of elements contaminated sediments and salinity changes

A. F. Aires, Universidade de Aveiro / Biologia; R. Freitas, University of Aveiro / Department of Biology - CESAM; C. Patinha, Universidade de Aveiro, E.F. Silva, University of Aveiro / Geosciences; E. Figueira, University of Aveiro / Biology CESAM

Coastal systems often serve as sinks for toxic elements, and changes in salinity, predicted to occur due to global climate change are expected to influence elements geochemistry in aquatic systems. The effects of these changes can also alter biota sensitivity and, therefore, salinity is considered to be a key factor in the functioning of coastal ecosystems, mainly on those organisms living in sediments, such as polychaetes, which also support much of the diversity at higher trophic levels. So, this work examines the interactions of elements contamination and change in salinity and polychaetes performance, highlighting modifications that coastal systems may undergo due to alterations driven by salinity change. Polychaetes were exposed to elements contaminated sediments (median sand and fine sand sediments, collected from contaminated areas from ria de Aveiro lagoon, Portugal) and salinities 21, 28 and 40, for 28 days. This study aimed to evaluate physiological (regenerative capacity of Diopatra neapolitana), behaviour (burrowing tests with Hediste diversicolor and Arenicola marina) and biochemical responses: indicators of cell damage (LPO) and rectification (SOD and CAT), and biotransformation (GSTs) enzymes. After exposure, both types of sediments had lower total elements concentration (TEC), when compared to original sediments, mainly in sediments with A. marina and H. diversicolor. Sediments exposed to salinity 40, mainly those containing H. diversicolor had even less TEC than remaining sediments, which seems that salinity changes may influence elements availability. LPO levels were higher at salinity 40 for H. diversicolor and A. marina, and at salinities 21 and 40 for D. neapolitana. Although polychaetes were able to increase the activity of SOD, CAT and GSTs, these defense mechanisms were not sufficiently efficient to fight against the excess of ROS, leading to LPO.Furthermore, in H. diversicolor, the burrowing behaviour was impaired in polychaetes in fine sand sediments and salinity 40. For A. marina exposure to median sand sediment for all salinities and fine sand sediment for salinity 40 led to a decrease in the burrowing kinetic in marine neapolitana individuals exposed at salinities 21 and 40, for both sediments, exhibited lower capacity to regenerate their body when compared to salinity 28 (control). Overall, this study demonstrates that variations in salinity can strongly affect elements availability. Interaction of both variables impacted polychaetes responses differently.

491 Do trace metal contamination and parasitism infestation influence the activity of the bioturbator Upogebia pusilla?

A. da Riva, EPOC, University of Bordeaux / UMR EPOC CNRS 5805; X. de Montaudouin, A. Cluet, P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; M. Bandimont, Université de Bordeaux / UMR EPOC CNRS 5805; G. Maire, P. Gourves, G. Daffe, A. LEGEAY, University of Bordeaux / UMR EPOC CNRS 5805

In marine environment, bioturbating species are considered as important ecosystem engineer species. Bioturbators are mainly benthic organisms living in the sediment. Their fossorial life style deeply alters the physical and biochemical properties of sediments. In marine soft-bottom environments, mud shrimp are considered among the most important bioturbators. Because of their intense burrowing activities, they exert a major influence on solute and porewater exchanges, habitat structuration and benthic community composition. The influence of mud shrimp on their environment is related to the intensity of their behavior. Several factors could influence such behavior, such as sediment properties and therefore modify their influence on the ecosystem engineer species. Regarding mud shrimp, only a few factors have been studied. Among them, the role of trace metals on mud shrimp fitness and bioturbation activities has never been investigated yet. Besides, mud shrimp are frequently parasitized by bopyrid isopods, known to have a deleterious effect on their host. Indeed, they deeply impair mud shrimp physiological state and potentially alter the bioturbation intensity. The aim of this study was to examine the role of a common trace metal (cadmium) and of bopyrid parasites on the physiology and the bioturbation activity of the mud shrimp Upogebia pusilla. We performed a 14-days ex-situ experiment evaluating the influence of Cd and/or parasite on the mud shrimp U. pusilla. Cadmium bioaccumulation and potential genetic responses to stress exposure were determined after 3, 7 and 14 days to trace metal exposure. The influence of both stressors on U. pusilla bioturbation activity was determined by evaluating sediment reworking rates of the mud shrimp after 3, 7 and 14 days to trace metal exposure.

492 Integrating ecotoxicology and ecology to advance understanding and prediction in multiple stressor research

R. Schafer, University Koblenz Landau / Institute for Environmental Sciences; J. Piggott, Trinity College Dublin / Zoology

Global environmental change is driven by multiple anthropogenic stressors. Conservation and restoration requires understanding the individual and joint action of stressors to evaluate the potential management measures. To date, most studies on multiple stressor effects have sought to identify potential stressor interactions, defined as deviations from null models, and related meta-analyses have focused on quantifying the relative proportion of stressor interactions across studies. These studies have provided valuable insights about the complexity of multiple stressor effects, but remain largely devoid of a theoretical framework for prediction of effects and null model selection. We suggest that multiple stressor research would benefit from) integrating additional null models from ecotoxicology and 2) selecting null models based on their mechanistic assumptions of the stressor mode of action and organism sensitivities as well as stressor-effect relationships. We present a range of null models and outline their underlying assumptions and applications. Moving forward, this meta-analysis requires multiple stressor research to shift its focus from identifying statistically significant interactions to the use and development of mechanistic (null) models. We discuss how ecotoxicological and ecological concepts will aid in achieving this.

Improving the Quality of Ecotoxicological Testing and Assessment

493 Updating the OECD Guidance Document 23 on aquatic toxicity testing of difficult substances and mixtures to include state-of-the-science approaches

W. S. Hunter, U.S. Food and Drug Administration / Center for Veterinary Medicine; G. Stoddart, C. Fathbender, PETA International Science Consortium Ltd.; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre

The Organisation for Economic Cooperation and Development (OECD) Guidance Document (GD) on Aquatic Toxicity Testing of Difficult Substances and Mixtures (GD 23) was first published in 2000 and provides crucial guidance that supplements OECD Test Guidelines. Since its release much experience has been gained in handling difficult-to-test chemicals in aquatic exposures as well as progress made in developing methods for testing difficult test chemicals. The GD was revised as recently as 2016 to include state-of-the-science approaches. We provide an overview of the updated GD 23. One significant revision was the expansion of the guidance on testing of poorly water soluble test chemicals. Attention was paid to updating exposure methods that do not employ a solvent in order to eliminate the need for a solvent control, and thus, reducing the number of animals used in aquatic toxicity tests. Another major revision was the addition of more detailed guidance for substances of unknown or variable composition, complex reaction products, and biological materials (UVCBs). The presentation also briefly describes other aspects of the updated GD of interest to those involved in aquatic toxicity testing. The updated GD 23 will help government agencies, industry, and contract research organisations conduct valid and reliable aquatic toxicity studies on difficult-to-test chemicals while minimising both the number of animals used and the need to repeat studies. The views, conclusions and recommendations expressed in this presentation are those of the authors and do not necessarily represent the policies or positions of the United States Food and Drug Administration, the PETA International Science Consortium Ltd., the International Council on Animal Protection in OECD programmes, the European Commission or the OECD.

494 Calibrating Non-Target Arthropod (NTA) Lower Tier Assessment Factors

F. Bakker, Eurofins-Mitos; S. Aldershof, Bioresearch and Evaluation; A. Dinter, Cheminova Deutschland GmbH & Co. KG / Global Regulatory Sciences; C. Elston, Syngenta Ltd; C. Mayer, BASF SE / Ecotoxicology; E. Pilling, Dow AgroSciences / Regulatory Sciences; G. Weyman, ADAMA; P. Neumann, Bayer AG

The OECD Guideline 491, Tier Assessment Factors for aquatic invertebrates (Tier 1), presents non-target arthropod (NTA) studies were calibrated against NTA full fauna field studies for a large array of species, 20 active ingredients (23 products) and wide geographic coverage in the EU. It was investigated whether the current assessment endpoints at lower testing tiers are sufficiently protective and whether the array of test systems is sufficiently comprehensive. Lower tier studies, both Tier 1 and Tier 2, with several test species were developed for calibration of Tier 1. For each test chemical, multiple NTA studies were included. For each product a Hazard Quotient (HQ) was calculated based on the most sensitive lower tier test result, both lethal and sublethal (only tier 2), and the test rate applied in the field study against which the HQ was calibrated. Thus, multiple-rate studies could yield more than one HQ. Values obtained were related to the longest duration of adverse effect observed in the field. With this information we derived limit values for assessment factors based on different field risk tolerance criteria, for example in-field recovery periods varying from 1 to 12 months. Phytophagous taxa were analyzed separately, but as no differences in
outcome with other taxa were observed, these were considered jointly. As expected Tier 1 studies had the most sensitive endpoint and consequently the largest HQ. Using the recovery endpoint, it was found that for the off-field HQ’s of 1, 6 and 250 delimited recovery ranges of 0 weeks (no effects), 4 weeks and 8 weeks, respectively in the off-field situation (hay meadow paradigm). For the in-field situation recovery intervals of 0-1, 1-2, 2-6, 6-12 and 12 months were delimited by HQ-values of 40, 375, 620 and 2500. Tier 2 studies could have lethal or sublethal endpoints. Using the most sensitive of the two and including a Vegetation Distribution Factor (VDF) of 5 the following HQ-values were derived for the off-field: HQ=1.7 for a no effect level. These HQ’s also correspond to 1 and 2 month recovery periods. For the in-field, using VDF=1, HQ’s are 1.3 for no effect and 6.6, 15, 60 and 560 for 1, 2, 6 and 12 months respectively.

495 The unforeseen consequences for animal welfare of the OECD TG 240 (MEOGRT) biological validity criteria E. Salinas, BASF SE / Experimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology

The Medaka Extended One Generation Reproduction Test (MEOGRT) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MEOGRGT brings together all aspects of the OECD chronic fish TGs 210, 234, and 229 into one test. OECD TGs include validity criteria as minimum standards for acceptable performance and particularly the biological control performance criteria are critical to assure relevant effects of a test chemical are detectable. Validity criteria assist regulators in determining study quality and reliability; studies that do not comply may be rejected and/or repeated. Compared to other fish TGs, the quantity of validity criteria in the MEOGRGT TG have increased and are more stringent, thus elevating the potential for failure and repetition. Other investigators have already noted a high incidence of study repetition following well established OECD fish TGs. Here we present data as is available for the MEOGRGT and currently very few laboratories can implement this highly complex TG. The MEOGRGT arose from an international validation effort and recently the data from 9 validation studies were published. We compared control performance in those studies against the existing MEOGRGT validity criteria to evaluate the compliance rate. Only 3 studies reported the control parameters corresponding to all biological control criteria and only 1 out of the 9 studies demonstrated successful compliance. The most prevalent deviation from the validity criteria was in the fecundity performance (4 out of 9 studies). Although some deviations from the validity criteria were minor, the failure to meet the fecundity criterion cannot be dismissed in a reproduction test where high fecundity is directly related to statistical power. The MEOGRGT fecundity validation criteria is in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRGT. The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.


Inherent variability in Non-Target Terrestrial Plant (NTTP) guideline testing of pestidilyzed cropland is in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRGT. The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.

497 An avian reproduction study historical control database: A tool for data interpretation J. Wheeler, Dow Agrosciences; P. Valverde-Garcia, Dow Agro Sciences LLC; T.A. Spack, EAG Laboratories / Specialist Projects & Histology; V.J. Kramer, Dow AgroSciences LLC / Ecotoxicology; M. Foudoulakis, Dow Agrosciences / RSRA ER; I. Barber, Dow Agrosciences

Avian reproduction studies are a regulatory requirement for pesticides in many regions. The data often require careful interpretation due to the nature of the study design and where we previously used some AdHoc studies we now consider the bird and mallard duck reproduction studies performed at the Evans Analytical Group LLC avian toxicology laboratory over the period 1985 - 2016. The analysis demonstrates the stability of reproductive parameters over time and good agreement to normal control ranges as required by the regulatory test guidelines. The major source of variation is shown to be within study variation. Recommendations for the use of historical control data for the interpretation of avian reproduction studies are made. We believe the analysis and evaluation presented here can facilitate the development of practical guidance that can be implemented in regulatory programmes requiring this test.

498 Experimental Design and Model Selection for Ecotoxic Risk Assessment J.W. Green, DuPont / Data Science and Informatics

Recent experience with regulatory requests for re-analysis of older studies using newer statistical methodology has resurrected an old statistical issue of designing a study to fit its objectives and the dangers of imposing a statistical structure on data not fit for purpose. There is a continual need to update statistical methodology as new ideas arise and data is aware to implement these methods become available.

Problems can arise when new methods are imposed on old experimental designs. Imagine buying a plot of land with a small cottage. If we tear down the cottage, but leave the cellar and foundation, and then build a mansion in its place but based on the existing foundation, the resulting structure can be unstable and severely restricted in functionality. This presentation will explore the relationship between experimental design and the type of statistical model that can be fit to the resulting data and endpoints that can be estimated or determined from the model. In some instances, newer methods can be applied without problem to existing data. In other cases, existing data cannot support newer methods. It is important to understand the data requirements of the methods or models we intend to use. The size effect that can be estimated or detected is critically important and is strongly related to experimental design and biological variability. There is a model underlying every statistical test used to derive a NOEC or estimate an ECx. The basic statistical model for a simple toxicity experiment is given by \( Y = \mu + \epsilon \), where \( \mu \) is the expected mean response in the 1st concentration, and the \( \epsilon \) are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another is what distribution is assumed for the errors or responses and what restrictions or assumptions are placed on the treatment means. \( \mu \) is it possible to determine the size effect that can be estimated or detected from a given dataset and it depends largely on experimental design and response variability. Statistical models used for hypothesis testing or regression estimates have data requirements. Model assessment tools are well established and should be used in fitting models to experimental data. Ignoring these tools or model requirements can lead to poorly estimated effects and misleading results. Understanding these concepts enables the scientist to make sound assessments of the data collected.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (I)

499 Integration of Risk Assessment and Life Cycle Assessment in the context of recycling wood waste into particleboard S. Haywood, R.A. Alvaranga, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology

Recycling of wood waste into particleboard has some environmental advantages, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality. Recycling of wood waste into particleboard has some environmental advantages, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality.
into particleboard. A need exists to investigate the local human health risks associated with recycling contaminated wood waste, while simultaneously considering other impacts on human health and the environment throughout the entire life cycle traditionally modelled with Life Cycle Assessment (LCA). The objective of this study was the combined use of local Risk Assessment (RA) and LCA to achieve a broader assessment of the sustainability of recycling contaminated wood waste into particleboard. The current scenario, in which the use of contaminated wood waste in particleboard is limited by Flemish government’s standards, is compared to a future scenario with a higher use of more contaminated wood waste. As a consequence, in the future scenario, a lower proportion of the contaminated wood waste will be incinerated with electricity (and heat) recovery. Modeling of the local air pollution is performed with the Impimiss Prognosis Air Concentration Tool (IMPACT) of the Flemish government. The LCA scope includes the particleboard industry, relevant upstream and downstream processes of the particleboard industry, and the incineration of wood waste. To integrate RA and LCA results on human health effects the concept of disability-adjusted life years (DALYs) is adequate as a common metric. Results will be presented at the conference.

500 Development of non-conventional LCA indicators for circular characteristics of bio-based products
K. Lokedi, University of York / Department of Chemistry; X. Bengoa, Quantis; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Biomass Systems; A. Ernstoff, V. Rossi, Quantis
This work is dedicated to the identification of key “un-conventional” indicators that demonstrate the sustainability and circular characteristics of promising bio-based products, complementing conventional life cycle analysis. Some of the new LCA complementary indicators proposed as a part of this study emphasise on resource efficiency and material circularity of bio-based value chain and include (but are not restricted to) waste circuity, critical material circularity, land-use efficiency and output quality services. The proposed indicators were drawn out of a comprehensive evaluation of more than 45 certification labels, schemes and initiatives associated with bio-based products, relevant international and national standards and 80+ scientific articles encompassing bio-product life cycle assessment. A current need for a harmonised sustainability certification protocol, coupled with an aim to develop an indicator-led assessment framework lead to the identification of potential gaps in criteria and indicators. Adoption of bio-based products has been identified as the one of the pathways to reach a sustainable economy. Some of the many advantages conceived from adopting bio-based value chains include development of waste-management infrastructure, job creation, SME’s and other environmental opportunities, contributing directly to seven out of 17 UN Sustainable Development Goals. The benefits of such systems approach can be realised only via quantitative and qualitative evaluation of the embedded environmental, techno-economic and societal impacts, all of which are a function of a product’s variables like feedstock type, technology-route, product’s functionality and application [1]. Life cycle assessment, a robust impact-led sustainability analysis tool than that of conventional LCA, is crucial for measuring the sustainability of bio-based products. The AO-based method invocation via useful holistic indicator also has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

501 Toward a more sustainable biochemical industry - Early stage assessments and methodological overlaps between life cycle- and techno-economic assessments of biochemicals
Aarnoudsen, DTU (Technical University of Denmark) / Division for Quantitative Sustainability Assessment DTU Management Engineering and DTU Biosustain; S. Sukumara, DTU Technical University of Denmark / DTU Biosustain; P. Fankte, Technical University of Denmark / Quantitative Sustainability Assessment Division
Existing Life cycle assessment (LCA) studies of biochemicals reveal that there are challenges that need to be overcome in order to reach an overall high sustainability performance. While in some cases biochemicals have lower global warming impacts compared to fossil-based chemicals, other impacts may become higher, like eutrophication. One of the major sources of environmental impacts of biochemicals is the growing of biomass, which in most cases today is corn. This has led to investment in assessing opportunities of using side streams, like leftover biochemicals is the growing of biomass, which in most cases today is corn. Transition Assessment and Research of Bio-based products include a vast range of traditional and innovative materials and substances for purposes other than food and energy such as wood and composite materials, bioplastics, adhesives, lubricants, paints and many other material categories feeding large economic activities. There is international recognition that developing a climate-smart bio-based economy is essential to the continuation of economic development, reduction of greenhouse gas emissions, and adaptation to climatic change. However, as bio-based products are ultimately obtained from land or sea, a specific attention has to be payed when considering additional exploitation. Changes of land/sea uses can rebound and cancel out environmental performances and impacts, due to their strong interrelationships. Indicative, critical material circularity, land-use efficiency and output quality services. The proposed indicators were drawn out of a comprehensive evaluation of more than 45 certification labels, schemes and initiatives associated with bio-based products, relevant international and national standards and 80+ scientific articles encompassing bio-product life cycle assessment. A current need for a harmonised sustainability certification protocol, coupled with an aim to develop an indicator-led assessment framework lead to the identification of potential gaps in criteria and indicators. Adoption of bio-based products has been identified as the one of the pathways to reach a sustainable economy. Some of the many advantages conceived from adopting bio-based value chains include development of waste-management infrastructure, job creation, SME’s and other environmental opportunities, contributing directly to seven out of 17 UN Sustainable Development Goals. The benefits of such systems approach can be realised only via quantitative and qualitative evaluation of the embedded environmental, techno-economic and societal impacts, all of which are a function of a product’s variables like feedstock type, technology-route, product’s functionality and application [1]. Life cycle assessment, a robust impact-led sustainability analysis tool than that of conventional LCA, is crucial for measuring the sustainability of bio-based products. The AO-based method invocation via useful holistic indicator also has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

502 A risk evaluation approach for indirect land use change associated to biobased products
D. Marazza, University of Bologna; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; V. Rossi, Quantis; J. Golaziewski, University of Warmian-Mazurski W Olsztynie
Biobased products include a vast range of traditional and innovative materials and substances for purposes other than food and energy such as wood and composite materials, bio-plastics, adhesives, lubricants, paints and many other material categories feeding large economic activities. There is international recognition that developing a climate-smart bio-based economy is essential to the continuation of economic development, reduction of greenhouse gas emissions, and adaptation to climatic change. However, as bio-based products are ultimately obtained from land or sea, a specific attention has to be payed when considering additional exploitation. Changes of land/sea uses can rebound and cancel out environmental performances and impacts, due to their strong interrelationships. Indicative, critical material circularity, land-use efficiency and output quality services. The proposed indicators were drawn out of a comprehensive evaluation of more than 45 certification labels, schemes and initiatives associated with bio-based products, relevant international and national standards and 80+ scientific articles encompassing bio-product life cycle assessment. A current need for a harmonised sustainability certification protocol, coupled with an aim to develop an indicator-led assessment framework lead to the identification of potential gaps in criteria and indicators. Adoption of bio-based products has been identified as the one of the pathways to reach a sustainable economy. Some of the many advantages conceived from adopting bio-based value chains include development of waste-management infrastructure, job creation, SME’s and other environmental opportunities, contributing directly to seven out of 17 UN Sustainable Development Goals. The benefits of such systems approach can be realised only via quantitative and qualitative evaluation of the embedded environmental, techno-economic and societal impacts, all of which are a function of a product’s variables like feedstock type, technology-route, product’s functionality and application [1]. Life cycle assessment, a robust impact-led sustainability analysis tool than that of conventional LCA, is crucial for measuring the sustainability of bio-based products. The AO-based method invocation via useful holistic indicator also has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

503 How to find sustainable applications for new materials and how to overcome the relativity of LCA
C. Som, EMPA Technology & Society Lab; R. Hirschi, EMPA / Technology and Society Lab; F. Piccinno, EMPA
The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to identify the most sustainable application fields for new materials that are still under development. This selection includes a 3-step method considering technical, economic as well as environmental criteria. So far, the method was best used for new materials that are replacing existing materials in a given application. But applying the MPAS in the case of a completely new kind of material or application field with no clear and existing competitor for comparison, the method revealed its limitations. Especially, the environmental assessment, that uses simplified LCA studies, is a relative approach. Another difficulty for the simplified LCA studies is when the production data of the material and, at the same time, the knowledge about the properties of the end-product are unknown and highly speculative. This is a common problem since the MPAS method is intended to support early stage development of new products. Here, we present an expanded and further developed MPAS method that mitigates exactly these limitations meaning that the environmental assessment can be performed without a comparison case and also without the necessity of a lot of data. The development and expansions of the MPAS method are applied to each of its three steps. However, the main development of the method is made to Step 3, the environmental evaluation of the material. Our solution here uses a highly flexible set of criteria that are specifically adapted to the various cases and that are mainly LCA based. This means that the environmental score can now be obtained regardless of the ability to estimate the production data of the material and of the knowledge about the exact properties of the end-product. This evaluation can be applied absolutely or relatively/comparatively. Furthermore, the criteria are expanded with other criteria that go beyond only LCA relevant aspects and also include aspects like circular economy. The method is illustrated with a case study on nanoporous carbonaceous material. As a result, the most sustainable applications for this nanoporous carbonaceous material are identified and used to set parameters to be achieved for
the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing the required amount of LCA data. This makes the method universally applicable.

504 Consumption and consumer footprint: LCA as pivotal methodology for assessing consumption patterns and ecocivilization

S. Sala, A. Cerutti, European Commission Joint Research Centre / Bioeconomy unit; V. Castellani, EC-JRC; M. Scocchi, European Commission Joint Research Centre / Bioeconomy unit

The European Commission has been developing an assessment framework to monitor the evolution of environmental impacts associated to the EU consumption. The assessment framework aims at supporting a wide area of policies, such as those related to bioeconomy, resource efficiency, ecocivilization and circular economy. The assessment framework is composed of two sets of consumption-based indicators: the Consumption footprint and the Consumer footprint. The Consumption footprint assesses the potential environmental impact of an apparent consumption, focusing on a territorial scale and accounting for trade, assigning the impact to the country where the final consumer is located. The Consumer footprint assesses the potential environmental impact of consumption, based on the results of life cycle assessment (LCA) of representative products purchased and used in one year by an EU citizen. The Consumer footprint allows assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/repairing and disposal). For the calculation of the Consumer footprint, the consumption of European citizens is split into five key areas (food, housing, mobility, household goods and electric/electronic appliances). For each area, a respective Basket of representative Products (BoP) has been built based on statistics on consumption and stock of product. For each of the five BoPs, a baseline scenario is defined, taking as reference the consumption of an average EU citizen in the baseline year 2010. For the subsequent years, data have been used for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspots analysis are then used as a basis for the selection of actions towards environmental burden reduction, covering either consumption pattern, behavioral changes, implementation of eco-solutions, or a combination of the previous. For each of the actions, a scenario has been developed, by acting on the baseline model and simulating the changes associated to the specific intervention. The LCA results of each scenario are then compared to the results of the baseline, to identify potential benefits or impacts coming from the implementation of the solution tested, as well as to unveil possible trade-offs.

Environmental Risk Assessment in Sediments

505 Assessment of risk from historic contaminants in sediments of the Elbe flood plain, using a multiple line of evidence approach

S. Heise, Hamburg University of Applied Sciences / Life Sciences; U. Rieth, Institut für Hygiene und Umwelt

The Elbe river has one of the largest catchment areas in Europe (150,000 km²) of which two thirds lie in Germany. While it was once considered to be one of the most polluted rivers of Europe, water quality has been improved since the fall of the Iron Curtain in 1989. Sediments, however, still carry the memory of an industrial past and are often “on the move”, transported by the current and especially during flood events to downstream sites. The question, where they originate, what chemicals they carry and how much of it may still be around, has been in the focus of several previous studies (e.g. Heise et al. 2008, Hillebrand et al. 2015). Little attention, however, had been paid to long-term to sediments in those ca. 1000 backwaters and flood plain lakes along the Elbe with regard to their contamination, their ecotoxicity and their mobility in times of high water discharges and flood plain submergence. Two studies, carried out in 2013 and 2014, were dedicated to this kind of structures with the task of evaluating a potential risk from these sites. Over a stretch of 230 km along the Middle Elbe, sediments from 25 backwaters were sampled, analysed for heavy metals and for Elbe-typical historic contaminants (HCH, HCB, PCB, PAHs, DDX). Additional lines of evidence in an ecotoxicological effects provided a distinct line of evidence and could be not simply related to analytically contaminant concentrations. - when integrating chemical, ecotoxicological and erosion stability data into a weight of evidence approach, high risks could be identified for 50 % of the sampled sites in 2013. - dating of sediment cores from 2014 pointed towards a strong impact of the 4 extreme flood events between 2002 and 2013 on the erosion of highly contaminated sediments from backwaters into the Elbe river.

506 Multiple lines of evidence for risk assessment of old sea deposits for ilmenite mine tailings in SW Norway

M. Schaumann, H. Trannum, K. Nudung, S. Oxnevad, NIVA / Norwegian Institute for Water Research

Annual discharge of this mine disposes up to 3 mill. tons of tailings contaminated with trace amounts of Ni and Cu sulfides. During 1960-94 the tailings were placed in two sea deposits, first in a sheltered fjord and then in a more exposed basin. After 1994 the tailings have been placed in a land-deposit. To protect the downstream watershed area, some of the metal contaminated drainage water is recycled, mixed with other discharge and fed into the water column at the site of the fjord deposit. In 2015 the deposit and reference sites were sampled for studies of macrobenthic communities, bionickel chemical fluxes, metal mobilization and metal uptake in gastropods and DGT probes. O2 and pH in the sediments were measured using micro-electrodes. The tailings were easily traced in the sediments by high concentrations of fine fractions, Fe, Ni, Cu and Co. Tailings were still abundant in the top 0-1 cm of the sediments at both deposit sites, but clearly less abundant at the sediment surface than in deep deposit layers and also less in the outer deposit basin than in the fjord deposit. Compared to Norwegian and European quality standards [1], Cu exceeded MAC-EQS (“Maximum Admissible Concentration”) for coastal sediments indicating a “risk of acute toxic effect” on marine organisms. The DGT-profiles showed that Fe and Mn was recycled within the sediments, whereas Ni and Cu leaked to the overlying water from mobilization centers consistently located in the oxidized sediments. The contaminant concentrations were found to exceed sediment quality guideline levels, bioassays were used to evaluate toxic effects resulting from contaminant exposure. Although the chemical analyses used for bioavailability assessment have been shown to be useful for predicting metal toxicity in sediments, the predictions for oxidized surface sediments can be quite poor, frequently owing to a broader range of factors influencing metal bioavailability including variability in phases that are easily oxidized or reduced (e.g. AVS and Fe(II)). In addition, laboratory-based bioassays may provide inadequate predictions of metal bioavailability and toxicity due to their inability to adequately replicate field exposure conditions. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the DGT technique for predicting metal bioavailability in sediments. The DGT device uses an ion-exchange resin (Chelex) which selectively accumulates divalent metal present in the sediment porewater and weakly-bound to the sediment particulate phase. The DGT metal flux measured at the sediment water interface (SWI) was compared to biological responses of organisms exposed to sediments contaminated with mixtures of metals, in the laboratory (amphipods and bivalves) and in the field (bivalves). To assist in the analysis of effects from the mixtures of the metals (Cd, Cu, Ni, Pb, Zn), DGT metal fluxes were normalised using water quality guideline values to account for predicted differences in the toxicity of the different metals. Strong dose-response relationships were found between normalised DGT metal fluxes and bioassays measured in the SWI. Acute toxicity endpoints, such as adverse effects to reproduction and survival of the amphipod exposed to laboratory conditions. The results of bioaccumulation were obtained for both marine and freshwater bivalves in laboratory and field set-ups. Differences in bioaccumulation between organisms exposed to identical sediments in laboratory and field set-ups highlighted the importance of including sediment quality assessments lines of evidence based on in situ evaluations of metal bioavailability.

507 In situ metal fluxes for the assessment of metal bioavailability in sediments

E.D. Amato, University of Antwerp / Department of Biology; S.L. Simpson, Central Water and River Research Institute / Environment Canada; A. D. Jolley, University of Wollongong / School of Chemistry; C.P. Marasinghe Wadige, University of Canada / Institute for Applied Ecology; W.A. Maher, University of Canada / Institute of Applied Ecology; A. Taylor, University of Canada / Ecochemistry Laboratory, Institute for Applied Ecology

Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS) and Fe and Mn were determined at the tailing site of a former mine in the Arctic. Metal oxidation states through time was determined using a parallel electrode array. The flux of metal from the sediments during the field experiment was measured using DGT and the exchange resin (Chelex) which selectively accumulates divalent metal present in the sediment porewater. Metal flux measurements were compared to bioassays measured in the SWI. Organic carbon (TOC) and fluxes of O2 and nutrient species were low throughout the investigated area; and the macrobenthic communities showed reduced number of species at the inner fjord site, but ecological status was classified as “good” at all sites and “very good” at the reference site. The metal fluxes showed that in addition to depth, fine fractions (< 63 µm) and Cu were the only significant environmental parameters explaining the variance in the benthic community data. We conclude that both the current discharge to the water column and the leaching of Cu and Ni from the sea deposits are likely to contribute to the moderate reduction of benthic biodiversity at the old deposit sites. [1] Guidance M-608, 2016. Norwegian Environmental Agency. 24 pp.

508 An Overview of the Refinements and Improvements to the USEPA’s Sediment

SETAC Europe 28th Annual Meeting Abstract Book
Spatio artificial sediment data to derive a Ti indicating that these were mo a factor of 10 d field with the rate. For worms comprised surviving animals and their weight, including yield and grow concentrations were measured at the start and end of the testing. Endpoints for both of the midge containing approximately 2 cm sediment and 1 L aerated spring water. Tests were the oligochaete experiment with fludioxonil the most sensitive sed mentioned above. In a previously performed spiked artificial sediment were performed with all sediment the use of field the amphipod species of a different taxonomic group, such as the midge. Assessment Team fungicide fludioxonil reflect the views or the policies of the USEPA. talk, we will focus on the testing methods and improvements that have been made in this work, including the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 test organisms for fungicides with a biocidal mode-of-action. To investigate i) the potential difference between the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 approach is protective, 28-d tests with fluoridoxinol-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa individual tests for each species and method, laboratories would report their averages for the test endpoints/measures. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA in

509 Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fludioxonil Lawrence Key, Alterra / Environmental Risk Assessment; J. Romão, University of Aveiro; X.H. Yin, Zhe Jiang Agriculture and Forestry University; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team In the EFSA scientific opinion on sediments, one of the oligochaete worms Lumbriculus spp. or Tubifex tubifex, supplemented with a second standard test species, Chironomus riparius or the amphipod Hyalella azteca, are proposed as Tier-1 test organisms for fungicides with a biocidal mode-of-action. To investigate i) the potential difference between the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 approach is protective, 28-d tests with fludioxonol-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa individual tests for each species and method, laboratories would report their averages for the test endpoints/measures. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA in

511 Effects of untreated wastewater dilution in surface waters on pharmaceuticals natural attenuation and on the community genomics: Implications for ERA S. Bagnis, M. Fitzsimons, Plymouth University; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; A. Tappin, Plymouth University; S. Comber, Plymouth University / Environmental Science The decreasing consumption and production of active pharmaceutical ingredients (APIs) in low and low-middle income countries (LMMICs) is of growing environmental concern owing to their possible ecotoxicological effects. This is related to the practice of direct discharge of untreated wastewater (DWW), which creates a heavily polluted area, named the “impact zone”. Little is known about the environmental fate of APIs in this area. Nevertheless, a few available measured environmental concentrations (MECs) of LLMICs show higher concentrations than for high-income countries with developed wastewater treatment infrastructures. Globally, the MECs of APIs in the “impact zone” are typically above 0.01 µg L⁻¹, which, if predicted, would trigger the environmental fate refinement of the environmental risk assessment (ERA). In the ERA PEC calculation, a default dilution factor (DF) of 10 is used, but in at least 53 countries worldwide, the local predicted median DF is lower than 10. There is no information available in the literature about the effects of low dilutions on the natural attenuation of APIs nor impacts of DWW. Furthermore, information on the effects of low dilution on mixtures of APIs is missing, hence necessitating the requirement for evaluation of biological endpoints for the impact zone ERA. This information is pivotal for the development of an impact zone ERA approach, and we are proposing an original approach to expand this area of chemical research. The bioaccumulation of a set of APIs was studied in batch tests at several levels of dilution. Nevirapine shows persistence across the experimental period and only the dilution is controlling the observed concentrations. Acebutolol and Diclofenac show a decrease in concentration of up to 90% as a result of a combination of dilution and biodegradation. The biodegradation at no dilution shows a behaviour consistent with the previous reported studies. As a consequence, the presence of APIs in a wastewater stream shows persistency but the reduction alone is responsible for the 70% of the removal. The TOC analyses do not show significant consumption rate changes caused by dilution. The results regarding the effects of the APIs mixture and the dilution on the microbial composition are been analysed through bioinformatic statistics, and will be presented if significant.

512 Active Pharmaceutical Ingredients Entering the Aquatic Environment From...
Effects of full-scale ozonation of treated effluent - Environmental impact in a receiving river

J. Fick, Umeå University / Department of Chemistry; T. Brodin, Umeå University / Department of Ecology and Environmental Science; J.D. Larsson, University of Gothenburg, Sweden / Department of Infectious Diseases; L. Norgren, Swedish University of Agricultural Sciences / Department of Biomedical Sciences and Veterinary Public Health; B. Ellor, UKWIR

This work reports on the ability of wastewater treatment works (WWTW) to remove active pharmaceutical ingredients (APIs), the variations within and between works, the effectiveness of trying to model removal and the risk of exceeding predicted no-effect concentrations (PNEC) in the environment. The research is based on data generated from two large UK-wide WWTW monitoring programmes. Taking account of removal of parent compound from the aqueous phase during treatment in combination with estimates of dilution available it is possible to prioritise the APIs of greatest risk of exceeding estimates of their PNEC in receiving waters for all WWTW in the UK. The majority of substances studied were removed to a high degree, although with significant variation, both within and between WwTw. Poorer removal (between influent and effluent) was observed for ethinyloestradiol, diclofenac, propranolol, the macrolide antibiotics, fluoxetine, tamofoxen and carbamazepine. All except the last two of these substances were present in effluents at concentrations higher than their respective estimated PNEC (based on maximum effluent concentrations from 45 WwTw on 20 occasions). The application of models to predict removal efficiencies are reported. Based on available dilution data as many as 890 WwTw in the UK (approximately 13% of all WwTw) may exceed exceedances of estimated riverine PNECs after mixing of their effluents with receiving waters. The overall degree of risk is driven by the toxicity value selected, which in itself is controlled by the availability of reliable and relevant data. Our purpose is to add further facts to the dataset and discussion, provides information to assist in the future management of these types of chemicals.

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Impact of a wastewater treatment plant upgrade on amphipods and other macroinvertebrates: individual and community responses

K. Peschke, Tübingen University / Animal Physiological Ecology; S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; K. Warm, GOL Water Ecology Laboratory Starzach; R. Trübskorn, University of Tuebingen / Animal Physiological Ecology

Conventional wastewater treatment plants (WWTWs) equipped with secondary and tertiary treatment steps do not or only partially remove micropollutants which makes them important point sources for the release of these substances in the water cycle. Micropollutants can cause short- or long-term adverse effects in aquatic organisms even at low concentration levels. One possibility to reduce the input of micropollutants into the water cycle is the upgrading of WWTWs with an additional purification stage such as ozonation or post-treatment with activated carbon. This research work is part of the joint research BMBF project “SchussenAktiv” funded by the German Federal Ministry of Education and Research (BMBF) and the Ministry of Environment, Baden-Württemberg, Germany. In this project, the efficiency of an additional wastewater treatment based on powdered activated carbon for the ecosystem of the Schussen river, a major tributary of Lake Constance, Southern Germany, has been investigated. Our project focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen river. Samples were taken up- and downstream of the WWTW, as well as before and after the upgrading of the WWTW. Gammarid populations from all sites were investigated with respect to sex ratio and fecundity of breeding females. In addition, analyses of heat shock protein (hsp70) levels and lipid peroxides allowed us to draw conclusions about prooxidative and antioxidative stress in gammarids. Macrozoobenthos community integrity was determined by means of the saprobic index as well as by the number of sensitive taxa (EPT index). Prior to the WWTW upgrade, the health status of gammarids as well as the integrity of the macrozoobenthos community was negatively influenced by the WWTWs effluent. After the upgrading of the WWTW, gammarids from the downstream site did not differ any longer from those collected upstream of the WWTW with respect to the investigated health parameters. Furthermore, the overall number of taxa and particularly the number of EPT taxa within the macrozoobenthos community downstream of the WWTW increased distinctly after the upgrade of the WWTW with the additional activated carbon step. We conclude that the efficiency of the activated carbon step to eliminate toxic and endogenous substances from the effluent can plausibly be related to the improved integrity of macroinvertebrate health and community structure in the connected river Schussen.
used to water supply and has been reported as contaminated by cyanoxins and pharmaceuticals. Therefore, this contamination increases costs to the water treatment and can cause toxic effects to the aquatic organisms and human health. The aim of this study was to test GreenLiverSystem to remove the contaminants, at the same concentrations that were found in the reservoir, using aquatic macrophytes. Egeria densa, Ceratophyllum demersum and Myriophyllum aquaticum were exposed to concentrations of paracetamol, diclofenac, and microcystin-LR using a laboratory model of the GreenLiverSystem for 14 days. Water samples were collected in 0, 1, 3, 7 and 14 days and plants samples were collected at the end of the experiment. Two control experiments were carried out in parallel. Water and plants samples were used to quantify the contaminants and plants samples were also used to evaluate the catalase and glutathione S-transferase activities. Plant species took up the contaminants and the removals of compounds were 93% for diclofenac and 100% for microcystin-LR. Our results showed that the plants antioxidant system was not activated and the GreenLiverSystem was a suitable methodology to clean the water and to implement in phytoremediation programs. Keywords: Green Liver System, Reservoir, aquatic macrophytes, phytoremediation.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health

517 Identifying hotspots of Antimicrobial Resistance Selection in the Natural Environment

J.B. Sallah, University of York / Environment; A. Boxall, University of York / Environment Department

Releases of antimicrobials into the environment increase selective pressures on environmental microbes contributing to the proliferation of antibiotic resistance (AMR) and perhaps the inevitable ‘post antibiotic era’. One of many challenges in understanding environmental AMR is the high cost and time required to provide widespread environmental monitoring. In lieu of this monitoring data, predicted environmental concentration (PEC) modelling based on pharmaceutical usage data has been demonstrated to be a useful tool in approximating antimicrobial exposures to the environment. Recently, attempts have been made to predict no-effect concentrations (PNEC) for selective pressures in the development of AMR. Coupling PEC and PNEC values provides a powerful tool to estimate the risks associated with a particular compound or class of compounds relating to AMR proliferation. Here we use this approach to identify hotspots where antibiotic exposure may be contributing to AMR selection for a range of different scenarios. Antibiotic usage data, data on metabolism, wastewater treatment and dilution data were used to determine PEC values, which were compared with reported PNECs to determine AMR hotspots for 56 compounds used in Wales as well as 9 chemical classes of antimicrobials in European Countries. Finally, using daily flow data, the approach was applied to a single wastewater treatment utility serving a population of approximately 18,600 persons with effluent discharge into the River Foss, UK to highlight the variation patterns in daily risk associated with AMR selection. Having illustrated the utility of this approach for a range of spatial and temporal scenarios, we believe that these results will be invaluable in informing future monitoring of antibiotics and AMR in the environment.

518 Urban and rural antibiotic resistance

C. McLauchlan, M. Cooke, Newcastle University; C. Keapp, University of Strathclyde / Civil and Environmental Engineering; J. Su, Y. Zhu, Chinese Academy of Science; D.W. Graham, Newcastle University / School of Civil Engineering and Geosciences

Soils are both a source and a sink for antimicrobial resistance (AMR). Despite growing awareness of AMR in the soil resistome, debate continues over responsibility for increased AMR dissemination in this important environmental reservoir. While soil AMR is innate, the relative abundance of antibiotic resistance genes (ARGs) in soil has significantly increased over the last 60 years since the industrialisation of antibiotics. The reasons (e.g., antibiotic misuse, agriculture) for increased ARGs in soil require further investigation to provide widespread environmental monitoring. In lieu of this monitoring data, predicted environmental concentration (PEC) modelling based on pharmaceutical usage data has been demonstrated to be a useful tool in approximating antimicrobial exposures to the environment. Recently, attempts have been made to predict no-effect concentrations (PNEC) for selective pressures in the development of AMR. Coupling PEC and PNEC values provides a powerful tool to estimate the risks associated with a particular compound or class of compounds relating to AMR proliferation. Here we use this approach to identify hotspots where antibiotic exposure may be contributing to AMR selection for a range of different scenarios.

519 Dissemination of extending-spectra β-lactamase E. coli carrying multidrug resistance and virulence factors in tropical rivers receiving hospital effluents

A. Laffite, University of Geneva / Institut Forel; V. Slaveykovka, University of Geneva / Département F.-A. Forel des sciences de l'environnement et de leau; J. Poté, University of Geneva / Department F.A. Forel of environmental and aquatic sciences

The occurrence and dissemination of antibiotic resistant bacteria and their resistance genes from clinical settings to environmental compartment have become a major concern because of serious threat human health worldwide. Given the serious clinical threat of Extended-spectrum β-lactamases (ESBL) and carbapenem-resistant Enterobacteriaceae (CRE), studies are carried out in many countries from clinical settings. However, there is the dearth of studies in environmental compartments for the presence of these high threat gram-negative bacteria. This situation is particularly alarming in developing countries in which the freshwater resources receive urban and hospital effluent water without previous treatment. Additionally, during the occurrence and dissemination of ESBL and CRE in sub-Saharan African Countries are very limited. The aim of this research is to assess the role of untreated hospital and urban wastewaters on the biological contamination of urban rivers receiving systems in the city of Kinshasa, Republic Democratic of the Congo. 147 E. coli strains resistant to 3rd generation of β-lactams (ESBL) were isolated from water samples isolated along 5 rivers receiving hospital effluents. They were analysed for their clonality and the presence of multidrug resistance and virulence genes. The results highlight a high level of clonality in strains (67 clones) and an important level of multidrug resistance regardless the sampling point. 53% of E. coli resistant to the 3rd generation of β-lactams were also resistant between 6 to 8 antibiotics. 14% of ESBL producers also carried virulence genes factors linked to E. coli pathotype determination. The geographical, ST1, ST2 E. coli isolates were carried by 1.3% 5.4%, 2.7% and 6.8% of the strains. These results indicate the human and environmental potential risk of tropical urban rivers. Indeed, ESBL strains carried by urban rivers are associated to resistance against numerous antibiotic classes (i.e. inhibitors combination, 4th generation of β-lactams, monobactams, carbapenems, aminoglycosides, tetracyclin, quinolones and phenicol classes) and may also carry virulence genes factors. The problems of multidrug resistance are not only linked to untreated hospital wastewater discharge in urban receiving system and are widely distributed along the river, thus highlighting the risk of surface water use.

521 Methods for determining selective endpoints of antimicrobials

A. Murray, University of York; L. Zhang, I. Stanton, University of Exeter; J. Snape, AstraZeneca Global Environment / Medical School; W. Gaze, University of Exeter / Medical School

Antimicrobial resistance is one of the most significant threats to modern society. Use, misuse and overuse of antibiotics clinically and in the community; in agriculture and inich culture results in antibiotics and antibiotic resistant bacteria being released into the natural environment. Environmental concentrations of antibiotics are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antimicrobial resistance. Currently, antibiotics are not risk assessed in terms selection for antimicrobial resistance in situ. This is largely because there is no standardised ecotoxicological assay which can determine which selective endpoints are affected. This work compares previously published methods for determining and predicting selective concentrations of antibiotics to two novel methods developed in this study. The first method tracks resistance gene prevalence over time in a complex community using qPCR, and the other is based on reduction in growth of a complex community. Results show that predicted no effect concentrations (PNECs) derived using standard ecotoxicological assays are not always protective against resistance selection. Currently, no published method for selective endpoint determination is always protective of the other; though there is good agreement between PNEC(s) (PNECs for resistance) published previously and PNEC(s) determined in this study. A novel method, based on growth of a complex community, is proposed for environmental risk assessment as it can be easily standardised, can rapidly generate selective endpoint data, and results show good agreement with more indepth data which tracks resistance gene prevalence over time. Results show that continued data generation and method optimisation is required to develop a reliable assay for determining PNEC(s) for environmental risk assessment of antimicrobials.

521 Determining the minimal selective concentrations of macrolides in a complex microbial community

J. Stanton, University of Exeter / Medical School; A. Murray, University of York; L. Zhang, University of Exeter; J. Snape, AstraZeneca UK Ltd.; AstraZeneca Global Environment; W. Gaze, University of Exeter / Medical School

Antibiotic resistant bacteria are present throughout ecosystems. Continuous release of antibiotics from human activity can and does lead to measurable concentrations in surface waters (mg/L - μg/L), however these are lower than minimum inhibitory concentrations (MICs) and concentrations used in the clinic. Due to these relatively low concentrations, until recently it was thought that selection for resistant bacteria did not occur within the environment. Research published in 2011 and 2014 by Guest et al. showed selection at low environmental concentrations using single species assays. The macrolide antibiotics, azithromycin, clarithromycin and erythromycin, were added to the European Commission’s Water Framework Directive’s priority substances
watchlist in 2015 due to their measured environmental concentrations (MECs) and predicted environmental concentrations (PECs) being higher than their predicted no effect concentrations (PNECs). The aims of this study were to investigate the selective potential of these three compounds in a complex microbial community and to determine minimal selective concentrations (MSCs) for each. A number of week-long evolution experiments were conducted at a range of macrodide concentrations. QPCR determined the presence of a variety of macrolide resistance genes (ermA, ermB, mshD and mef [f/fA] and mfl) within the community. Change in prevalence of resistance genes, when in the presence of antibiotic, was compared to change in prevalence when no antibiotic was present. Out of all of the genes tested, the ermF gene shows a selective response at the lowest concentration for all three macrodide antibiotics. No significant selection is seen for ermA at 50µg/mL, but we do see significant selection at 75µg/mL for all three compounds. The highest current MEC for any of these macrolide compounds is 4µg/L (erythromycin·H₂O). Our data suggests, therefore, that current environmental concentrations of the macrolide compounds do not select for resistance genes in a complex microbial community.

522 Impact of multi-year exposure of agricultural soils to antibiotics on the soil resistome and mobilome.

C.H. Lau, Y. Tien, Agriculture and Agri-Food Canada; E. Topp, Agriculture and Agri-Food Canada (AAFC)

Antibiotics are entrained into agricultural soil through the application of animal manures and sewage sludge. In order to understand the potential long term effects of antibiotics on soil microorganisms, field plots were established in 1999 that have since received annual applications of a mixture of tylosin, chlorotetracycline and sulfamethazine, and a second series of plots was established in 2010 that receive a mixture of erythromycin, clarithromycin and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 mg kg⁻¹ soil⁻¹, and plots have been continuously cropped to soybeans. A library of large cloned fragments was constructed using DNA sampled in 2014 from plots receiving the highest application rates, or no antibiotics. The library was cloned into antibiotic-sensitive Escherichia coli, and antibiotic resistance genes (ARGs) in the library were discovered by identifying E. coli clones that grew upon plating growth media containing various antibiotics. Genes encoding resistance to many classes of antibiotics including the sulfonamides, tetracyclines, macrolides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e00989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrons and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. intI1, sul1, strA) were much more abundant in soils exposed to antibiotics whereas the vast majority of targets were not detectably increased in abundance. Overall, these results suggest that genes associated with integron cassettes are amplified in soil following repeated exposure to antibiotics.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a more realistic point of view

523 Inter-annual monitoring of microplastics in marine intertidal sediments of the Firth of Forth

M. Hartl, Heriot-Watt University / Centre for Marine Biodiversity & Biotechnology, Institute of Life and Earth Sciences; Z. Lawrence, Heriot-Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology; C. Holmes, A. Deery, Heriot Watt University / Centre for Marine Biodiversity & Biotechnology Institute of Life and Earth Sciences; J. Blumenröder, Heriot Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology; P. Sechet, Heriot Watt University / Centre for Marine Biodiversity Biotechnology Institute of Life and Earth Sciences; R. Wood, Heriot Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology; N. Mears, Heriot Watt University / Centre for Marine Biodiversity & Biotechnology School of Life Sciences; S. Paterson, Heriot Watt University / Centre for Marine Biodiversity Biotechnology Institute of Life and Earth Sciences; M. Vugiana, H. Walker, F. Kinsley-Willis, J. Mccrecot, Heriot Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology

Microplastics (MP) are defined as plastic pieces smaller < 5mm are commonly found in the marine environment and originate either consumer care products and plastic production plants or from the disintegration of larger pieces. MPs need to be monitored in order to evaluate the effectiveness of Government initiatives to reduce plastic debris in the environment. The aim of the present study, therefore, was to contribute to the development of a hitherto lacking quantitative long-term marine MP database. We present the results of a three-year pilot project in the Firth of Forth, point to innovations in sampling and containment prevention, as well as the limitations. Sediment samples were obtained in triplicate from intertidal sites in May2014, May & Sept2015, May & Sept2016, using glass bijoux tubes as miniature cores and sealed with metal screw caps, processed using a density separation procedure and the polymer types determined using FT-IR spectroscopy. The results showed that there are high numbers of plastic particles (34-4,800 kg⁻¹) and fibres (1,700-4,300 kg⁻¹) along both shores of the Firth of Forth. The number of Fibres was generally higher than MP particles. There was no apparent pattern of spatial distribution. Although a spike in MP particles was observed in Sept2015 and May2016, there was no significant difference in MP particle concentrations between May 2014 and May 2017. There was also no significant difference in MP fibre concentrations during the same three-year period. There was also no evidence of seasonal fluctuations in MP concentrations. The results show that, for intertidal sediments in the Firth of Forth, the MP concentration has remained stable. This is significant baseline information and will be instrumental in assessing the effectiveness of Government policy regulating industry and consumer behaviour towards the production and use of particularly single-use plastic products. However, in order to compare results between countries and laboratories, for the purpose of gaining a more global insight into the microplastics contamination issue, more standardised sampling and extraction procedures need to be developed.

524 Do nanoparticles cause stress effects on microalgae? An infrared spectroscopy study.

M. Déniel, Institute of molecules and materials of Le Mans / Physique des Interfaces et des MésoStructures; N. Errien, Institute of molecules and materials of Le Mans; A. Caruso, laboratory Mer Molecule Santé; f. lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Molecules of Le Mans IMM UMR CNRS

Nanoparticles are constantly used at world level leading to their presence in the aquatic environment leading to possible particle interactions with living organisms. The potential impacts of nanoparticles on living microorganisms are discussed. In particular, the role of interactions between microalgae and nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is known to monitoring material chemical composition. In this work, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polystyrene nanoparticles. After 48h or 72h of interaction, responses of the microalgae in comparison with known stress mechanisms. Nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polystyrene nanoparticles. After 48h or 72h of interaction, responses of the microalgae in comparison with known stress mechanisms. Nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polystyrene nanoparticles. After 48h or 72h of interaction, responses of the microalgae in comparison with known stress mechanisms. Nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polystyrene nanoparticles. After 48h or 72h of interaction, responses of the microalgae in comparison with known stress mechanisms. Nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms.
526 Interactions of carbon nanoparticles and benzene on mytilus mussels, Mytilus galloprovincialis

A. Barranger, University of Plymouth / School of Biological Sciences; Y. Aminot, University of Plymouth; M. Bann, Laboratory of Biochemical and Environmental Toxicology; S. Sforzini, Università Del Piemonte Orientale Amadeo Avogadro / Department of Sciences and Technological Innovation (DiSt); V.M. Arlt, Kings College London / Department of Chemistry; A. Khlobystov, University of Nottingham / School of Chemistry; A. Varegno, University of Piemonte Orientale / Department of Sciences and Technological Innovation DiSt; J.W. Readman, University of Plymouth / Biogeochemistry Research Centre; A. N. Jha, Plymouth University / Biological Sciences.

The production and discharge of nanoparticles has grown extensively over the last few years, raising concerns over their potential impact on environmental health, either alone or in combination with other anthropogenic contaminants. The study, funded by Natural Environment Research Council (NERC), UK aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polycyclic aromatic hydrocarbons (PAHs) can interact with each other to differentially modify their potential toxicity. To probe this hypothesis, marine mussels were exposed for 3 days to benzene and five different types of carbon nanoparticles, [C20 fullerene and multi-walled carbon nanotubes (MWNNTs)], both alone and in combination with BaP. Tissue specific distributions and concentrations of CNPs and BaP were determined in exposed mussels. To enhance the analytical traceability of these CNPs in biological systems, some nanoparticles were labelled with rare elements. CNP uptake was followed by ICP-MS and/or HPLC-UV, with the BaP uptake tracked by GCMS. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technology targeting 15 stress response pathways. Contrasting results were obtained when comparing G. terebralis to C. fluminea. CNPs and BaP were found to affect the genotoxicity of BaP. Different responses were also observed with the transcriptomic studies. Microarray analysis identified several key biological processes (e.g. DNA metabolism, cytoskeleton, oxidative stress and heat shock response) as differentially regulated in CNP-exposed mussels. The study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

527 Trophic transfer of CuO NPs and Aqueous Cu: from worms to fish - a proof of concept study

T. Lammel, University of Gothenburg / Dep of Biological and Environmental Sciences; A. Thit Jensen, Roskilde University / ENSPAC; C. Mouneyrac, Université de Lorraine / DIEM; Y. Aminot, University of Plymouth / Biogeochemistry Research Centre; A. N. Jha, Plymouth University / Biological Sciences.

Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic marine organism. This study uses the model freshwater bivalve Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 µg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP affected C. fluminea behavior and physiology, suggesting an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

528 Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study

T. Lammel, Divio, LIEC - Université de Lorraine - CNRS; LIEC; CNRS; S. Piwon/Daane, Université de Lorraine - UL / LIEC - CNRS - UMR 7360; B. Sohn, University of Lorraine / LIEC, CNRS; S. Devin, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; M. Auffan, CEREGE / International Consortium for the Environmental Implications of Nanotechnology; C. Mouneyrac, Université Catholique de l'Ouest / UBL, Mer Moleculaire Santé; L. Calvo, Université de Lorraine / LIEC, CNRS; S. Devin, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; M. Auffan, CEREGE / International Consortium for the Environmental Implications of Nanotechnology.

Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic marine organism. This study uses the model freshwater bivalve Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 µg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP affected C. fluminea behavior and physiology, suggesting an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins

529 Applications of Luminous Bacteria Enzymes in Toxicology and Ecology

V. Kratsavuk, Siberian Federal University / Biophysical; E. Simbeka, Siberian Federal University / Biophysics

A new approach in developing bacterial bioluminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to obtain, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were proposed, wherein the bacterial coupled enzyme system NAD(P)/H:FMN-oxydo-reductase-luciferase substitutes for older methods using living organisms. The immobilized reagent Enzymolum was used to facilitate and accelerate the development of the bioluminescent enzymatic method. Theoretical and practical aspects of the toxicological assays. The reagent is easy to use and convenient to be applied not only in toxicity studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

530 Toxic and adaptive effects via luminescent assay systems of different toxicity including metallothermien A (mta) were measured using RT-qPCR. The total Cu body burden of tubifex increased by 3 and 3.5 µg Cu/d tissue after 7 days of exposure in CuO NP- and CuCl2 spiked sediment, respectively, suggesting that NP uptake into the organism occurred. Cu accumulation was also observed in fish receiving CuO NP and CuCl2–spiked food packages, in particular in intestine, and was concomitant with upregulation of mta transcription. The increase in the intestinal Cu concentration and mta expression in CuO NP-exposed fish was higher than in the control, but did not reach levels measured in CuCl2–exposed fish. At the same time the amount of Cu egested with the feces was significantly higher than in the CuCl2-treatment. These results suggest that transfer of CuO NP along the food chain may be limited compared to dissolved Cu. We suggest future studies on how NP bioavailability and accumulation in fish is influenced by other important factors, such as exposure dose, time and NP properties upon biotransformation by the foraging organism.

Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Depament of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in biogagnostics is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biogagnostics is explained by the variety of reactions to external stimuli, which fulfill their physiological and biochemical plasticity. In this regard, it seems very important to find the reactions of fungal cultures adequately reflecting their response to external stimuli in different conditions. The essential biogenic fluorophores such as NADH, tryptophan, melanin, ergosterol, pyridoxine, riboflavin, FAD, and FMN can be monitored instrumentally by spectroscopic techniques. The aim of the present study was to investigate the features of fluorescence spectra of fulamens fungi cultivated under different concentrations of source of bioavailable and nor readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalosporium chladosporioides, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of SB RAS. The filamentous fungi Chalosporium and agar based medium contained a varying level of sucrose (0.3% and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the exciting radiation (250, 280, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (under soaking of the NPs original- and engineered) UV-excitation consist of two overlapping bands. The UV-band with maximum at 300-350 nm under excitation at 280 nm is a protein-like fluorescence, and the band in the blue region with the maximum at 400-450 nm under excitation at 310-370 nm is emission of fungal chromoproteins like NADH and or melanins. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and not readily bioavailable carbon. Therefore we consider this research as promising on the way of using fungal fluoropores to assess responses of filamentous fungi to external stimuli.

533 Effect of surface functionality on Fe3O4 nanoparticles toxicity
L. Kulypkova, Moscow Aviation Institute; P. Uchanov, Institute of Ecology and Evolution RAS / Laboratory for soil ecological functions; S. Patsaeva, Lomonosov Moscow State University / Depament of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of Ecotoxicological Soil Analysis; K. Kydralieva, Institute of Chemistry and Chemical Technology

Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Depament of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in biogagnostics is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biogiagnostics is explained by the variety of reactions to external stimuli, which fulfill their physiological and biochemical plasticity. In this regard, it seems very important to find the reactions of fungal cultures adequately reflecting their response to external stimuli in different conditions. The essential biogenic fluorophores such as NADH, tryptophan, melanin, ergosterol, pyridoxine, riboflavin, FAD, and FMN can be monitored instrumentally by spectroscopic techniques. The aim of the present study was to investigate the features of fluorescence spectra of fulamens fungi cultivated under different concentrations of source of bioavailable and nor readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalosporium chladosporioides, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of SB RAS. The filamentous fungi Chalosporium and agar based medium contained a varying level of sucrose (0.3% and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the exciting radiation (250, 280, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (under soaking of the NPs original- and engineered) UV-excitation consist of two overlapping bands. The UV-band with maximum at 300-350 nm under excitation at 280 nm is a protein-like fluorescence, and the band in the blue region with the maximum at 400-450 nm under excitation at 310-370 nm is emission of fungal chromoproteins like NADH and or melanins. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and not readily bioavailable carbon. Therefore we consider this research as promising on the way of using fungal fluoropores to assess responses of filamentous fungi to external stimuli.
Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
C. Porte, IDAEA-CSIC / Department of Environmental Chemistry; M. Blanco, IDAEA-CSIC; A. Maceda-Veiga, University of Barcelona / Department of Animal Biology

New developments of analytical techniques have allowed the effective identification and characterization of lipids and the development of lipidomics, which has recently emerged as a key technology for human disease research and discovery of biomarkers. However, on an environmental toxicology context, studies are still few, in spite of lipids being considered key molecules for the bioaccumulation of chemicals. This work applies ultra-high performance liquid chromatography coupled to high resolution mass spectrometry (UPLC-HRMS) to characterize the lipidomic gene signalling pathways involved in the fish species Barbatula meridionalis, Squalius laietanus collected along the Ripoll River. Sampling sites included upstream (reference) and downstream (urban and industrial discharges) areas. A total of 130 lipid species, including phosphatidylcholines (PC), PC-plasmalogens (PC-P), cholesterol esters (CE), triacylglycerols (TG), diacylglycerols (DG) and sphingomyelins were detected in the muscle tissue. Partial least squares discriminant analysis (PLS-DA) allowed a clear separation of the lipidome of fish from polluted and reference sites. Specifically, a relative increase of CEs (18:1, 20:4, 22:5, 22:6) and some PC-Ps (32:0, 36:4, 36:5, 38:6) was detected in the muscle of B. meridionalis sampled in polluted sites. In contrast, the lipidome of S. laietanus from polluted areas was characterized by a significant increase of TGs and PC-Ps and a concomitant decrease of PCs with a high number of double bond (36:5, 38:6, 40:6, 40:7). The results suggest potential lipid oxidation of highly unsaturated PCs, particularly in S. laietanus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CE), possibly due to an increase in the energy demand to respond to stress in polluted sites.

Lipidomics profiles distinguish fish from organochlorine pesticide contaminated lakes compared to control lakes
N.D. Denslow, M. Nouri, University of Florida / Physiological Sciences; K.J. Kroll, University of Florida / Physiological Science; C.J. Martyniuk, University of Florida / Physiological Sciences; V. Dang, Iowa State University

The organochlorine pesticide (OCP) contamination of Lake Apopka is one of the most studied cases of contamination in the USA. The lake of Apopka is contaminated with several OCPs; and the hazard they may represent (II)

Animal Biology

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Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (II)

541 Nanotechnology: When shading effects through agglomeration of carbon nanotubes (CNT’s) are confused with toxicity by media and the public - a case example revisited
D. Schwab, Adolfo Merkle Institute / Materials Science

Engineered nanomaterials are relatively new contaminants with that can enter the engineered nanomaterials under investigation did not directly affect the algal viability, but indirectly reduced the algal growth via shading and agglomeration. To our surprise,
this press release led to a cascade of secondary articles and events. On the one hand, some online newspapers used our article to produce alarming articles about the dangers of nanoparticles for the environment (example translated from German: “Nanoparticles Identified as Potential Environmental Killers” [2]). On the other hand, some individuals used the press release to draw the oversimplified conclusion that all engineered nanomaterials will eventually agglomerate and therefore be harmless. Nevertheless, most of the media took over the message with no or minor modifications. The press release also triggered surprising responses from within the research institutions. In this presentation, I was invited to briefly summarize the different responses that went to this press release, and re-iterate the short- and long-term lessons learned from this case study. Most importantly, the ‘real’ work for a scientist writing a press release starts after its publication. News on topics of public concern such as the toxicity of engineered nanomaterials are very closely watched and instrumentalized both by the pro- and the anti-nano community for their respective intentions. Reactions on press releases concerning these topics have to be monitored closely, wrong quotations must be corrected and biased interpretations must be adjusted, in order to provide correct scientific information for the common public. The reward for this work is an overall more balanced communication of the results. [1] Schwab, F. Bucheli TD. Lakehe LP, Magrez A. Nowack B. Sigg L. Knauer K. 2011. Are carbon nanotube effects on green algae caused by shading and agglomeration? Environ Sci Technol 45:6136-6144. [3] Georgescu V. 2011. Nanopartikel als potenzielle Umweltkiller ausgemacht. www.lifegen.de/newsisp/shownews.php?p=getnews&n=2011-11-09-3109&pc=02. Accessed 22 Nov 2017 Acknowledgements and Disclaimer - Schwab, F was supported by an Ambizione fellowship of the Swiss National Science Foundation (grant number 168187). Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the Adolphe Merkle Institute or the SNSF. This work has not been subjected to their review and no official endorsement should be inferred. The author reports no other conflicts of interest and is responsible for the content of the abstract and presentation.

542 Nanotechnology: Communicating scientific findings through media – what could possibly go wrong? Lessons learned from Schwab’s nanotubes G. Oberg, UBC / BIES; A. Seal, University of British Columbia / School of Journalism

There is no single effective method for scientists to communicate their findings with the media. Unfortunately, Dr. Fabienne Schwab found this out after publishing a press release about the effects carbon nanotubes (CNTs) have on green algae. When the story hit the press, mainly through an article in Der Spiegel, many readers reacted with fear. The article mentioned a study that suggested CNTs might cause cancer in humans. While research on the environmental and health risks of microplastics is still in its infancy, the public has already concluded there are unacceptable risks and, consequently, demands for action. This puts environmental toxicologists and chemists in an uncommon position, namely that public awareness of a potential environmental issue is way ahead of an evidence-based assessment of the actual risks. To further complicate the matter, researchers face a fundamental dilemma: Current narratives on the negative implications of (micro)plastic pollution create public awareness and promote change towards more sustainable economic practices, e.g., with regard to circular economy. However, these narratives are in many cases not backed by scientific evidence. The question is now: How can we promote positive societal change and at the same time stay true to the scientific principles? In my talks, I will not present final answers to this question but rather provide a diagnosis of the recent microplastics debate. I will argue that plastic pollution represents a challenge to our disciplines with regard to the following fundamental aspects: 1) absence of a common risk understanding, 2) bias when dealing with information-scarce situations, 3) lack of mechanisms to prioritize environmental issues, 4) lack of mechanisms for consensus-building regarding the risk of environmental stressors. I will further argue that the field of plastics pollution represents an ideal playing ground to explore, discuss and advance these aspects. This will be crucial to get our disciplines fit to deal with the wicked problems, we face in the Anthropocene.

546 Ocean Literacy – changing attitudes and behaviour of society in the face of the problems of the oceans A. Borga, Arts-Tecnalia / Marine and Coastal Environmental Management The H2020 project ResponSEAll (www.responseable.eu) is trying to raise awareness around six key-stories (fishing, eutrophication, renewable energies, coastal tourism, microplastics, and ballast waters), within the four European regional seas. Under the DAPSIWRM framework (Drivers, Activities, Pressures, State, Impact, Wellbeing, Responses, Measures) we are developing products to change attitudes and behaviour of different actors related to each story, but also to the society at large, from children to adults, trying to test the changes in those attitudes. The products include videos, cartoons, serious games, interactive tools, specialized courses, etc. Our aim is that if scientists and society have a shared understanding of science and risk communication regarding the problems of the oceans, these can be solved through the individual and collective changes in our attitudes towards the oceans in our daily lives.

544 Microplastics: The risks of plastics – perceived or real? M. Kotterman, IMARES / Fish

Plastic has not only become a major research topic, it is also broadly covered in popular news. As result the general public knows about the plastic soup and how dangerous it is, supposedly, for wildlife and ultimately for human health. However, the history of plastic research is peculiar. Some of it was straightforward; wildlife choking in plastic does not need much additional proof or QC QA. But, as with many new research topics, the first articles about the dangers of plastic were soon followed by others. The focus was on the presence of small plastics particles even in the oceans. Research on plastic ingestion by wildlife continued, but was absent, as most of the published articles did not have proper controls. And if they did, it became apparent that many of the plastic fibres observed in the samples were a result of cross contamination by air. Secondly, while plastic particles do not behave very differently from other particulate matter with respect to absorption of organic contaminants, all known equilibrium processes of contaminants between particulate matter, biota and water were blatantly ignored. Contaminants in open seas would first sorb strongly to plastics, to desorb readily in the gastrointestinal tract of fish, leading to higher bioaccumulation of pollutants like PCBs in the food chain. The fact that the amount of ingested plastic is still almost negligible compared to the natural food intake makes these claims even more difficult to uphold. Therefore, it was disappointing that even Science published an article about the dangers of plastic microparticles for fish larvae, while the manuscript did not comply to the journals own quality standards. And as it seems now, the described research has not even been performed. So, besides the obvious and clear detrimental effects of plastic debris in the environment, an important concern of plastic may be that research on the environmental impact of plastics is not always conducted following proper scientific guidelines. In this presentation I will also discuss shortly the more recent progress in plastic research, such as the exposure of humans to plastic particles.

545 Lost in translation: Do we communicate the risks of (micro)plastics in the right way? M. Waagen, Norwegian University of Science and Technology / Department of Biology

While research on the environmental and health risks of microplastics is still in its infancy, the public has already concluded there are unacceptable risks and, consequently, demands for action. This puts environmental toxicologists and chemists in an uncommon position, namely that public awareness of a potential environmental issue is way ahead of an evidence-based assessment of the actual risks. To further complicate the matter, researchers face a fundamental dilemma: Current narratives on the negative implications of (micro)plastic pollution create public awareness and promote change towards more sustainable economic practices, e.g., with regard to circular economy. However, these narratives are in many cases not backed by scientific evidence. The question is now: How can we promote positive societal change and at the same time stay true to the scientific principles? In my talks, I will not present final answers to this question but rather provide a diagnosis of the recent microplastics debate. I will argue that plastic pollution represents a challenge to our disciplines with regard to the following fundamental aspects: 1) absence of a common risk understanding, 2) bias when dealing with information-scarce situations, 3) lack of mechanisms to prioritize environmental issues, 4) lack of mechanisms for consensus-building regarding the risk of environmental stressors. I will further argue that the field of plastics pollution represents an ideal playing ground to explore, discuss and advance these aspects. This will be crucial to get our disciplines fit to deal with the wicked problems, we face in the Anthropocene.

543 Discussion Nanotechnology

547 Discussion Microplastics

544 General discussion with panel of all speakers about topics emerging from the session

549 Wrap-up and closing

A. Leopold, Calidris Environment BV / Calidris Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Aajo, ECHA-European Chemicals Agency

Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (I)

550 Development of a diagnostic toolbox for ecological effects of pollutant mixtures and application to evaluate results from the third Joint Danube survey

A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; T. Seiler, RWTH Aachen University / Ecosystem Analysis; A. van den Brink, Alterra Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University

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A framework for environmental mixture risk assessment (MRA) has been suggested and Environmental Sciences Institute (HESI) and Environmental Stewardship and Sustainability Organization; S. Bopp, EC Beasley, Down; S.E. Belanger, The Procter & Gamble Company / Environmental Application of new statistical distribution approaches for mixture risk material to explore the applicability of the concept and its consequences for risk empirical data beco better conceptualize and operationalize the concept. However, more and more suitable alternatives. In summary, we conclude that, although the identification of the various methods to data gaps, (ii) the challenge of tiering the various approaches the ranking of mixture components. Additional we will discuss: (i) the sensitivity of the various methods to data gaps, (ii) the challenge of tiering the various approaches for risk driver identification, and (iii) the question whether a risk-based ranking is the optimum approach, or whether hazard- or exposure-based methods can be suitable alternatives. In summary, we conclude that, although the identification of drivers of mixture risk would constitute a major step forward to systematize and simplify the seemingly overwhelming complexity of chemical exposures encountered during human health and environmental risk assessments, the concept is currently not yet fit for purpose. Important steps remain to be taken, in order to better conceptualize and operationalize the concept. However, more and more empirical data become available from monitoring studies that provide ample material to explore the applicability of the concept and its consequences for risk management.

552 Application of new statistical distribution approaches for mixture risk assessment A. Backhaus, T. Kortenkamp, Brunel University London / Institute for Environmental Research / Department Bioanalytical Ecotoxicology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health Mixtures relevant for human health or the environment can easily contain dozens or even hundreds of chemicals. However, those components do not contribute equally to the toxicity of a mixture, but rather there is often a mixture hypothesis that only a few very few chemicals dominate the mixture risk. The European Commission has therefore emphasized in its communication the need to “identify chemical substances that are the main drivers of mixture toxicity”. This could tremendously help to steer future chemical monitoring efforts and risk mitigation measures. However, it is currently unclear how a common definition of the term “driver of mixture toxicity” would look like. Therefore, the main drivers of mixture toxicity can be defined statistically, without assuming that all mixture components contribute equally to the overall toxicity. We introduce an approach that is based on a stepwise elimination of mixture components and focuses on identifying the “main drivers of mixture toxicity”. The developed toolbox was applied to the Danube case study, to facilitate evaluation of the very comprehensive data set from joint Danube Survey 3. The toolbox concept proved to be practical, simple and promising for further studies, with fairly high diagnostic power.

553 Towards the development of a framework for applying non-target chemical analysis data within exposure and risk assessment T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; R. Parmar, ARC Arnot Research Consulting / J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology There is an increasing trend towards multi-targeted and non-target analysis (NTA) screening methods to increase the number of analytes monitored in biomonitoring and environmental samples. While the opportunities for advances in chemical analytical capabilities have shown substantive development over recent years, application of information related to data reported from NTA represents a challenge to the field of exposure modelling. For instance, there is no framework for screening for the appropriate use of NTA data in chemical exposure assessment. Recommendations include a number of suggestions regarding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.

554 A common framework for the assessment of human and ecological risks from pollutant mixtures in European surface waters - case study with > 30 chemicals co-occurring in the Danube A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting; S. Ermer, Brunel University London / Institute of Environment, Health and Societies; D. De Zwart, DELZ Ecosoft / Centre for Sustainability Environment and Health; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences Wildly exposed to an infinite number of different combinations of chemicals. There is evidence that single substances that are present below their individual threshold effects can still be of concern and contribute to combined effects. A framework for environmental mixture risk assessment (MRA) has been suggested by Backhaus and Faust (2012), however MRA is often hampered by limited data availability. An ecological Threshold for Toxicological Concern (ecoTTC) approach has been recently developed based on a database of more than 100 000 acute and chronic aquatic toxicity data. The tool allows for the calculation of predicted no effect concentration (PNEC) derived from the underlying data to which an assessment factor (AF) is applied depending on the comprehensiveness of the available data. The ecoTTC distribution, from which the ecoTTC value is derived by calculating the fifth percentile. Other types of chemical toxicity distributions (CTD) are also possible i.e. distribution of acute (LC50) or chronic (NOEC) ecotoxicological data without applying any AF. It is common practice to predict combined effects and risks based on information of the mixture components, most of the time based on the concept of concentration addition (CA). For this case study the sum of risk quotients has been used as a surrogate for CA based predictions. The risk quotient for the mixture (RQmixture) is based on the summation of the risk quotients of the individual substances. This approach is conceptually different from CA because the involved PNECs might be based on different groups of species and using different AF. However, it can be used as a screening level approach. If a RQmixture > 1 is identified, the MRA can be refined by using the sum of toxic units, based on LC50 data. The case study is based on chemical monitoring data in European rivers, which give realistic environmental concentrations and co-exposure scenarios to a relevant number of chemicals. Available ecotoxicological values have been gathered for the identified chemicals from regulatory sources when available, or from the literature and existing database. The possible use of the ecoTTC approach and other type of acute and chronic toxic units (TD) for screening for the appropriate use of NTA data in chemical exposure assessment. Recommendations include a number of suggestions regarding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.
assumptions about modes of action are introduced. We tested the utility of the scheme by using data on the levels of more than 300 chemicals that occur together in the river Danube, from the Joint Danube Survey 3 (JDS3). For each of the 54 sites along the river Danube we ranked the chemicals in terms of their contribution to a mixture effect, separately for algae, daphnia and fish. We found that the overall mixture toxicity was driven by only approximately 10 chemicals. Substances not yet defined as priority substances under the EU Water Framework Directive made a substantial contribution to combined exposures. We also assessed possible combined risks to humans by evaluating whether water drawn from the Danube would be fit for human consumption. Overall, exposures of concern for humans could not be detected at higher tiers of the assessment. We conclude that the protection goals defined in the Water Framework Directive for freshwater aquatic communities are not achieved for combined exposures at many sites along the Danube.

555 Pesticides do rarely come alone, except in risk assessment - Risk indices of ranked spray series of the project COMBITOX

B. Schoeller-Narke, RWTH Aachen University / Institute for Environmental Research / Institute for Environmental Research; S. Bar, German Federal Environment Agency UBA / Section Plant Protection Products; B. Daniels, RWTH Aachen University / Institute for Environmental Research; T. Frische, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology; R. Ottermanns, M. Roß-Nickoll, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; A. Sybertz, RWTH Aachen University / Institute for Environmental Research; C. Ulrich, German Federal Environment Agency UBA / Section Plant Protection Products; S. Knüllmann, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology. In the European Union, legislation so far strictly regulates plant protection by means of chemical pesticides on the level of single products. Common agricultural practice and manifold pest pressures lead to the exposure of non-target organisms to complex mixtures in a spray series. In the on-going COMBITOX project, we collated a dataset for the actual application patterns of pesticides in 12 representative crops in terms of pesticide application rates from the years between 2007 and 2015. The data was used for classification of sprayseries by typical mixture patterns, sequences and toxic pressures. Combining all information on empirical use patterns and their regional and temporal variation, we calculated indicators of use intensity and environmental risk. Toxicity exposure ratios (TER) were calculated using standard toxicity data (aquatic & soil organisms) from two publicly available databases PPDB (Lewis et al. 2016) and ECOTOX (US EPA 2017) and the mere application rates without consideration of exposure pathways. Only for focal sprayseries, first and higher-tier risk indices including mandatory risk management measures for different compartments were computed according to the standard approach as conducted by the UBA within the PPP-authorization procedure in Germany. In sum, 29 risk indices were computed (TERsingle, TERsingleM). Mixture risk indices were calculated based on the concept of concentration addition from single-substance TER and summed up per application date. In general, patterns of pesticide use showed that tank mixtures and spray sequences are predominantly in all crops that were considered in our studies. From the data, we revealed that crops group together in classes of use patterns. The cereals received a wide range of different pesticides classes in medium intensities during the whole spraying sequence; vine and apple orchards were dominated by fungicides and high-intensities. Risk exceedances became relevant if multiple individual TER-values (TERsingle) were already close to the critical TER trigger values. Our results emphasize the relevance of the nowadays largely non-regulated tank mixtures for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimes as well as effect estimates from appropriate mixture toxicity models in order to describe the “total risk” of the common chemical plant protection practice.

Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (I)

556 Time-dependent effects of two fungicides and their mixture on enchytraeid and earthworm communities under field conditions

J. Amoss, S. Bart, INRA/AgroParisTech; C. PELOSI, INRA (Institut National de la Recherche Agronomique); C. Thiel, INRA, IFR INRA/AgroParisTech. According to the current regulation for the registration of pesticide protection products on the market, the environmental risk assessment of pesticide use is generally performed under laboratory conditions. Very little information is available in nature, where multiple stresses occur. In this study, we assessed the effects of two commercial formulations of fungicides, i.e., Cuprafo Micro® (composed of 500 g/l dimethoate, 50 g/l oxamyl, 50 g/l thiram, 50 g/l dimethoate, 133 and 133 g/l diminoxydron), and the mixture of both on two groups of terrestrial oligochaetes (Lumbricidae and Enchytraeidae) after 1, 6 and 12 months (i.e., t1, t2 of exposure under field conditions. We also assessed the feeding activity of soil organisms using the bait lamina method. Our results showed a lower Shannon index for earthworms in the treatment with the mixture of both pesticides (i.e., 1.51 ha of Swing Gold® and 4 kg ha of copper) and in the treatment with the Swing Gold® at ten times the recommended dose (i.e., 15.1 ha) after one and six months. We also found a lethal effect of Swing Gold® on anecic earthworms at t1, while an effect of copper on anecic earthworms was not observed at t1. We observed no overall significant difference in total feeding activity, enchytraeid diversity and between treatments with or without pesticide at different sampling periods. In the Swing Gold® treatment, earthworm community did not recover twelve months after pesticide application. We suggest thus going beyond the ISO norm 11268-3 (2014) - for the study of the effects of pollutants on earthworms under field conditions - Oligochaeta community and other functional endpoints (e.g. organic matter decomposition with the tea bag method) over two years to better assess environmental risks of plant protection product use and their mixtures. Keywords: Cuprafo Micro®, Swing Gold®, agroecosystems, feeding activity

557 Toxicity of imidacloprid and thiacloprid towards four Colembolan species C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; C. van Haren, G. Mainardi, Vrije Universiteit Amsterdam / Department of Ecological Science; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science. Folsomia candida has been used for assessing the toxicity towards non-target soil organisms to pesticides. In this study, we assessed the toxicity of two additional soil organisms, F. candida and F. fimetaria, to the neonicotinoids imidacloprid and thiacloprid. We tested four species at two concentrations of the pesticides (557 ppm and 1114 ppm). The results suggest a specific mode of action of imidacloprid towards the earthworm community and other functional endpoints (e.g. organic matter decomposition with the tea bag method) over two years to better assess environmental risks of plant protection product use and their mixtures. Keywords: Cuprafo Micro®, Swing Gold®, agroecosystems, feeding activity. For a pesticide to be registered for use, the lethal and sublethal effects on non-target invertebrates since the 1960s, but only in the 1990s a standard reproduction test was performed. The species tested presented good control performance and of epoxiconazole and thiacloprid on two groups of terrestrial invertebrates since the 1960s, but only in the 1990s a standard reproduction test was performed. The results suggest a specific mode of action of imidacloprid towards reproduction, with EC50 of 0.10 mg/kg dry soil and for F. candida of 0.26 mg/kg dry soil. H. nitidus was slightly less sensitive with an LC50 of 1.6 mg/kg dry soil and an EC50 of 0.40 mg/kg dry soil. Thiacloprid was tested on S. curviseta, F. candida and H. nitidus, with a survival of the first one being least sensitive (LC50 of 27 mg/kg dry soil), followed by F. candida (LC50 of 5.2 mg/kg dry soil) and H. nitidus being the most sensitive with an LC50 of 2.3 mg/kg dry soil. Thiacloprid was more toxic to the reproduction of S. curviseta (EC50 of 2.6 mg/kg dry soil) followed by F. candida (EC50 of 1.5 mg/kg dry soil), and H. nitidus (EC50 of 1.3 mg/kg dry soil). The different species tested presented similar sensitivities towards thiacloprid and imidaclopid, and in the treatment with the exception of S. curviseta. The results suggest a specific mode of action of thiacloprid towards reproduction, a trend that has been found in all tests, except for H. nitidus that presented around the same sensitivity to both survival and reproduction. The species tested presented good control performance and consistency in the results, pointing towards a possibility to be used in toxicity tests. Non-target arthropods (NTAs) must be studied. Sublethal effects such as behavioural changes have been reported in NTAs exposed to some pesticides, with avoidance behaviour – that is, individuals displaying a significant movement away from the pesticide to a pesticide – being of particular interest. More research is necessary to better understand pesticide avoidance behaviour so that population consequences of such behaviour can be estimated. We aimed to develop an efficient method to quantify changes in movement behaviour and identify avoidance behaviour in relation to pesticide exposure in the predatory mite Typhlodromus pyri, a model species and a well-studied mite found in fruit orchards and ornamental crops. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mite movement behaviours when exposed to these in comparison to a control arena. We found that distances walked by mites were reduced by up to 87% compared to the control when exposed to 0.1 μg ml-1 deltamethrin, and that 54% of individuals exhibited movement behaviour when exposed to 0.1 μg ml-1 acetamiprid. Overall, 87% of individuals exhibited movement behaviour when exposed to 0.1 μg ml-1 acetamiprid. Overall, 87% of individuals exhibited movement behaviour when exposed to 0.1 μg ml-1 acetamiprid.
exhibited avoidance behaviour when exposed to acetamiprid or dimethoate. We report the variable effects of 3 insecticides on a range of standard movement behaviours in *T. pyri*, including distance walked, time moving/not moving, velocity and meandering behaviour. We also report avoidance behaviour measured as the time taken to become trapped in the test arena glue boundary due to attempts to escape the arena. Our results complement existing knowledge of sublethal pesticide effects on NTs by quantifying movement behaviour changes in *T. pyri*. We are also adding to the knowledge of avoidance behaviour, which is an area of growing interest. We hope to improve the understanding of population-level consequences from changes in movement behaviours caused by pesticide exposure.

559 Should oral exposure in *Hypoaspis aculeifer* tests be considered in order to keep them in Tier 1 test battery for ecological risk assessment of PPPs? T. Natal-da-Luz, CFE - Centre for Functional Ecology / Department of Life Sciences; T. Gevaert, CFE Centre for Functional Ecology and Hogeschool Gent, Education, Health and Social Work, University College Ghent; C.S. Pereira, CFE - Centre for Functional Ecology / Department of Life Sciences University of Coimbra; M. Antão, EFSAS - European Forests Safety Authority / Pesticides; J. Sousa, University of Coimbra / Department of Life Sciences

The recent scientific opinion of EFSA addressing the state of the science on risk assessment of plant protection products (PPPs) for non-target arthropods highlighted the need for the inclusion of other relevant exposure routes, besides contaminated soil, in tests from lower tiers. The reproduction test with the predatory mite *Hypoaspis aculeifer* (OECD 226) is currently being calcu

560 Plant protection products in agricultural soils - Do active ingredients show a comparable pattern in worms and in soil? T. Schmidt, IES Ltd / Ecotoxicology; H. Viric Gasparic, University of Zagreb Faculty of Agriculture / Department for Agricultural Zoology; R. Bazok, University of Zagreb Faculty of Agriculture / Department of Agricultural Zoology; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology, S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology

The environmental risk assessment of plant protection products on soil organisms is mainly based on the outcome of laboratory and extended laboratory studies (EFSA 2017). However, the link from the laboratory to realistic field conditions over several seasons is not well established. Currently no validated trigger for bioaccumulation factor (BAF) is available (EFSA 2017). One available approach for filling this gap is proposed by combining experimentally determined residue data from earthworms and data from degradation studies in the field. Earthworms were sampled at different seasons from eight fields in Croatia and analysed for 26 active ingredients. The concentrations of 26 analysed active ingredients were 0.000-0.247 mg/kg worm fresh weight with a mean of 0.005 mg/kg. The percentage of samples with values below the limit of detection (LOD), values below the limit of quantification (LOQ) = 0.001 mg/kg) and values above LOQ was 29, 42 and 29 %, respectively. Based on publicly available draft assessment reports from EC and EFSA, degradation parameters (DT90, DT10) were used to calculate degradation curves and the current concentration in soil at the date of worm sampling. By comparing analysed residues in worms and calculated concentrations in soil, a substance-specific bioaccumulation factor could be calculated. In the case of imidacloprid, the analysed residue levels in earthworm samples from the fields tended to increase with time whereas the calculated concentrations in soil decreased with time as expected, resulting in a supposed increasing bioaccumulation potential of imidacloprid under field conditions. The procedure proposed here – in the absence of analysed soil data – is a simple estimation which combines field history data with data from publicly available draft assessment reports. This approach may be useful for the assessment of the bioaccumulation potential of an active ingredient from a plant protection product under realistic field conditions.


Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances, are necessary to ensure a high level of protection of human and animal health, and of the environment. In aquatic organisms, trigger values for the identification of bioaccumulative (“B”) and very bioaccumulative (“vB”) substances are bioconcentration factors (BCF) of >2000 and >5000, respectively, obtained from fish flow-through studies according to OECD 305. However, Annex XIII of the REACH regulation does not define similar trigger values for bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the BvB criteria in the scope of the PBT guidance revision. For this aim, the study comprised the following soil experiments: 1) Literature research on available bioaccumulation factors (BAFs) both in open scientific literature and in regulatory data from several OECD 317 studies and performance of correlation analysis between soil-substance-properties, BCF and BAF values. 2) Performance of bioaccumulation studies according to OECD 317 with the earthworm Eisenia fetida using the four model substances endosulfan, methoxychlor, 2,4-D and PCB153. 3) Proposal of a trigger value for identification of bioaccumulative substances in terrestrial organisms based on the literature research and the performed experimental results. The results clearly showed that organic carbon content of the test matrix used in the tests influences the BAF, whereas no clear correlations between log Kow, log KEC or similar substance properties and the BAF were observed. Additionally, no correlation was found between bioaccumulation properties and substance-specific BCF from fish studies and BAF determined with earthworms. Therefore, lipid- and C-normated BSAF should be used for the assessment of terrestrial BAF. Kinetic BSAF from both experimental studies and literature-derived values ranged from 0.21 to 14.8. Based on the data evaluated in the present work, a BSAF trigger value of 1.00 is proposed as a general trigger to identify bioaccumulative substances. Other triggers like other de sequoted residues at the end of the elimination phase are discussed.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy

562 Developments and recommendations on the practical use of Social LCA S. Di Cesare, CRAD / Department of Economic Studies; A. Zamagni, Ecoinnovazione / LCA and Ecodesign Laboratory; J. Garcia, SCORE LCA; F. Silveri, University of Chieti-Pescara / Department of Economic Studies; A. Lanfranco, Eacobt; C. Petri, University of Chieti-Pescara / Department of Economic Studies

Social LCA is a multi-criteria, multi-stakeholder and multi-methodology approach that provides useful, transparent and science-based information on social and socioeconomic performance of a product throughout its entire life cycle. In this study, a systematic literature review was carried out dealt with within these aspects: the scope of S-LCA, its purpose, the social dimension outside S-LCA (i.e., analytical tools, procedural and managerial tools, currently used for monetizing, assessing, reporting and communicating social aspects, and their main differences with respect to S-LCA); impact assessment methods; users and uses of S-LCA. In addition, an experimentation was conducted through a practical case study based on literature, with the following goals: (1) to test the applicability and practicability of Social LCA; (2) to observe whether there is a methodology to identify social hotspots along the whole life cycle, and in particular in the remaining phases of the life cycle, such as raw material production and end-of-life; (3) to show how those results may complete environmental LCA and other social approaches. The product chosen is a Photovoltaic (PV) Module. The analysis carried out clearly pointed out that S-LCA is an evolving field, and many developments are envisaged, both at the level of methodology and results interpretation and communication. More in detail, the main limits of the S-LCA methodology identified in this analysis are
related to: methodological framework for S-LCA, goal&scope definition (in particular regarding the system boundary definition), data access, and use of qualitative data, methodologies and selection of indicators for the impact assessment phase. The strengths of the methodology are related to its capability of making the assessment of the product more complete, adding its social aspects to the environmental and economic ones, in addition to the increased transparency and traceability along the value chain. On the basis of the main challenges for S-LCA identified in this study, recommendations were idenitified, for further development and implementation of the methodology. The implemented study showed that there is a need for broad improvements of both methodological and communicative issues. To carry out a S-LCA study could be a way to manage social risk thanks to the identification of social hotspots, and to help companies building a targeted strategy for future development of social policies.

563 TBD

564 Social significance analysis of products - considering negative and positive social impacts along the supply chain of leather products

S. Neugebauer, RWTH Aachen University / INAB - Institute for Sustainability in Civil Engineering; M. Traverso, RWTH Aachen

Given that extirpation of leather industries is facing constant discussions on social compliance mostly in relation to bad working environments and thus cause severe social impacts for different stakeholder groups along the supply chain due to e.g. unhealthy working conditions. In order to determine social impacts occurring during the leather production processes, social life cycle assessment’s (S-LCA) implementation is of major importance. Practical implementations have to consider indicators and impacts determining social hotspots along the supply chain and should in addition provide information on social challenges and chances by means of negative and also positive social impacts. When assessing products’ life cycles the inclusion of positive social impacts is crucial, as most of the S-LCA indicators can be both positive or negative. Thus, this study aims at providing a social significance analysis (SSA) determining social hotspots along the supply chain including social impacts considering negative as well as positive consequences. Existing social indicators are included, addressing relevant stakeholder groups and impact pathways, e.g. fair wage. New indicators are defined where needed, e.g. to represent the rights for indigenous people affected. The assessments are performed by means of secondary databases, e.g. Social Hotspot Database, and by including primary data gathered at production sites of the European leather producer. The results will provide the challenges and chances of European leather production including the different stakeholder groups affected (e.g. workers) but also positive/negative directions of each social impact category defined (e.g. fair wage as a positive and negative indicator and utility as a purely positive indicator). The SSA is based on the S-LCA of European leather production using standardised social critical and ethical topics along the supply chain, e.g. existence of labor laws. Relevant social hotspots are identified. Depending on the indicator direction, social consequences (e.g. benefits in societal health resulting from non-exhausting work hours) can be determined for the stakeholder groups. The inclusion of positive impacts may function as an incentive for improvement and guide the way towards future developments within the European leather industry. The results may also be transferred to further product groups in the global textile and leather industry.

565 Integration of sustainability in industrial research and innovation: perspectives from ArcelorMittal's experience

A. Hettenger, M. Caraty, R. Turconi, ArcelorMittal / Sustainability RD; P. Cortijo, Utopies

The iron and steel industry is both a large contributor to greenhouse gases emissions and a provider of a key material for society’s development, being used in a wide range of market sectors such as infrastructure, transport, construction and packaging. Because of its complexity and complex supply chain, to provide sustainable development it is essential to ensure efficient production processes, optimizing the use of resources, valorization of byproducts, but also to explore the other stages of lifecycle of products that use steel, i.e. to adopt the holistic approach of Life Cycle Assessment. Lifecycle thinking enables ArcelorMittal - the world’s largest steel producer - to promote sustainability not only in its own operations but also in the use of its products by customers for many years. To this end a research team dedicated to sustainability and lifecycle assessment has been supporting the process and product research within the group. However, with more than 1,000 researchers in 12 research centers globally and hundreds of projects carried out every year, it is impossible for a single team to cover systematically the research performed. To this goal, the “Sustainable Innovation Tool” has been developed to enable the researchers of the group to self-assess their projects sustainability. Using the tool, they evaluate environmental and social aspects of their new processes and products and engage in a learning curve for an improved sustainable performance. The presentation will describe the collaborative development of the tool, the different phases of testing and the current start of the deployment across 6 research programs. We will draw on this experience to provide elements that supported its success, pitfalls to avoid. The company is at the start of this journey and seeks a continuous progress, and possible paths for a better integration between our current assessment of industrial research and generic frameworks such as the sustainable development goals will be discussed.

566 Social footprint of a packaging waste deposit-refund system in Spain

L. Moscoso, 2.0 LCA consultants; B. Weidema, Aalborg University; A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fullana, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI

We present a social footprint assessment of implementing a deposit-refund system (DRS) applied to beverage packaging waste in Spain. In a DRS consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. The social footprint developed by Weidema et al. is an example of how to quantify social impacts of income redistribution and the sum of all productivity-reducing externalities related to an activity. It is calculated by a top-down approach using input-output data. This method can be understood as a ‘streamlined’ social LCA. We applied its two general components: the income redistribution impact (IR): the increase (or loss, if negative) in utility caused by the transfer of money from one societal group to another, and the productivity impact (loss) from missing governance (PG): the difference between the actual purchasing-power corrected value added and the potential value added when all productivity impacts are internalised. The social footprint of an activity can be defined as SF = IR + PL. We compared two scenarios, namely the current situation for household packaging waste in Spain in 2014 (system A), and a hypothetical scenario (system B) where a DRS is implemented. The functional unit was the total amount of packaging waste to be managed annually. Primary data for the two scenarios were obtained from the environmental and economic studies performed as part of this project. Data to quantify the social footprint were obtained from the database Exiobase v.3.3.10, which was implemented in the software SimaPro. The results show that the social footprint for both systems involves a net social benefit. However system B reduces this benefit by 50% compared to system A. Introducing this DRS system in Spain is expected to lead to a net loss in social benefit compared to the existing system. The social benefit of the increased recycling is more than outweighed by the social costs induced by the activities required to achieve these higher recycling rates (collection manually or automatically of packaging waste in shops and supermarkets and the related transport). This is an example of how a social footprint, together with a powerful tool like Exiobase, can pave the way for an operational approach to social LCA, avoiding excessive data requirements and the long lists of impact indicators currently proposed for bottom-up approaches.

567 Poster spotlight: TH226, TH227, TH228

Developments in the use of bioassays for chemical and environmental risk assessment (I)

568 Application of Equilibrium and Toxicokinetic Models to Understand the Behaviour of Organic Chemicals in In Vitro Toxicity Tests

J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Toxicity testing in the 21st century is expected to rely increasingly on in vitro assays, which now cover a wide range of endpoints including cytotoxicity, receptor binding, protein interactions and DNA binding. In most cases, dose-response relationships from in vitro toxicity tests are reported using nominal concentrations in the test medium despite the known challenges such data introduce for comparing results across different test conditions and between different chemicals and for quantitative in vitro in vivo extrapolation (QIVIVE), Equilibrium partitioning (EQP) and toxicokinetic (TK) models have been proposed in the literature to address some of these issues. The main limitation of equilibrium partitioning models is that instantaneous distribution is assumed and hence uptake kinetics into cells/tissue, cell growth/division and the potential for degradation in the test system cannot be directly included in the calculations. The main objective of this study was to develop a toxicokinetic model (TK) for simulating the behaviour of organic chemicals in in vitro toxicity tests and compare the results to a previously developed EQP model. The toxicokinetic model was applied to a set of hypothetical non-ionic organic chemicals under different scenarios (e.g., biotransformation half-life) and then the results compared with a previously developed in vitro mass balance modeling tool based solely on equilibrium partitioning. We also applied the...
EQP model to a specific ToxCast assay (ACEA_T47D_80hr_negative assay; cytotoxicity) to illustrate the value of the modelling approaches for QIVIVE and hazard/risk assessment. For relatively persistent chemicals (or in cells/tissue with limited metabolic competency), the simulated mass distribution using the toxicokinetic model is similar to the equilibrium partitioning model output for test durations greater than 12 h. In such cases, the EQP modeling approach is deemed suitable to study the effect of given concentrations on static exposure results. The model can be used to predict water-soluble toxic units in environmental monitoring is generally scarce. As a potential solution, we suggest the application of in vitro bioassays for the prediction of bioaccumulation factors for fish. Moreover, the well validated experimental exposure assessment might be challenging for pesticides and pharmaceuticals that are organic acids, due to their unusual partitioning behaviour. Hydrophobic acids are typical ligands for serum albumin and are consequently strongly bound to medium proteins in in vitro assays, while the hydrophilic acids show a less reliable models are available to calculate the binding of neutral chemicals to lipid, protein, medium and cells, the binding of organic acids to biological matrices like cell culture media and cell suspensions on the one hand, but also for direct measurement of exposure (i.e., Ccell). Because polymers like polydimethylsiloxane that are typically used for solid phase microextraction (SPME) are not suitable for charged chemicals, C18-coated SPME fibres were used in this study, that have been previously reported to have high sorption capacities for charged chemicals. Eight organic acids were chosen for the experiments: diclofenac, 2,4-D, ibuprofen, naproxen, tobramycin, warfarin, triclosan, and gentamicin. To study acid partitioning behaviour, the SPME fibre and water was established within 4 h and the determined fibre-water distribution ratios were reproducible (SD ± 1.0 log units). Because the sorption of some of the chemicals to the fibres was concentration dependent, it was required to calibrate the fibres for the desired concentration range. The SPME method was applied to measure Ccell in cell culture media. At low chemical concentrations the results from the binding experiments agreed with the predictions from a mass balance modelling approach. However, saturation of the medium was observed at high chemical concentrations and further experiments will be necessary to investigate for which chemicals and at which concentration levels saturation occurs and if it is required to incorporate non-linear binding into existing exposure models for in vitro bioassays.

570 A versatile and low-cost open source pipetting robot for automation of toxicological and ecotoxicological bioassays

L. Nuesser, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; S. Steffens, RWTH Aachen University, Institute for Environmental Research / Institute of for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis; E. Salomons, OptiWater; N. Ruchter, Universität Duisburg-Essen / Aquatic Ecology; M. Schumann, University of Duisburg-Essen / Aquatic Ecology; R. Doering, RWTH Aachen University / Institute of Hydraulic Engineering and Water Resources Management; C. Bruell, RWTH Aachen University; H. Schuettromp, RWTH Aachen University / Institute of Resource Management and Water; P. Allenspach, Technical University of Dortmund; O. Tschiensel, Technion Israel Institute of Technology / Civil and Environmental Engineering; H. Hollert, RWTH Aachen University / Institute for Environmental Research; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre

The contrasting demands of performing bioassays in compliance with regulatory tier 1 endpoints for a technological solution is to realize automated semi-static exposure using the pipetting robot (1 h interval). Thus, we were able to confirm that any attempt to keep exposure concentrations as constant as possible will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, the pipetting system can be used in a variety of different setups and environments. Because its construction and operation are very cost-effective and do not require any specialized personnel, provisioning of instructions to replicate this design has makes automation technology accessible to a much higher number of laboratories around the world.

571 An intestinal fish cell barrier model to assess absorption of poorly soluble organic chemicals in vitro

H. Schug, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Toxicology, F. Beggio, Firmenich / DRAP, C. Debonneville, Firmenich / Research and Development; F. Berthaud, V. Laubscher, Firmenich SA / DRAP; F. Müller, Z. Ronder, Firmenich / Environment, Product Safety and Regulatory Affairs; K. Schirmer, Eawag / Environmental Toxicology

Permation of organic chemicals from the aquatic environment across cellular barriers is a critical step for accumulation in organisms, such as fish. To better understand the underlying processes, we aim to study the role of the fish intestine as barrier for hydrophobic and volatile chemicals. The function of the intestine in these processes is experimentally impractical to assess on a routine basis. Additionally, hydrophobic and volatile chemicals are difficult to work with, due to their low water solubility and high volatility. Therefore, we here combine a recently developed in vitro epithelial barrier model using the rainbow trout (Oncorhynchos mykiss) intestinal cell line, RTgutGC, and a newly constructed chamber that enables stable chemical exposure concentrations. In this setup, we measured the permeation of 10 fragrance compounds with a range of volatility (logKoc = 5.8 to -2.2) and hydrophobicity (logKow = 3.6 to 5.7). The RTgutGC monolayer partly presented a physical barrier for the permeation restricting the fragrance transfer from the apical to the basolateral compartment. The calculated permeation rates across the cell layer combined diffusion controlled permeation and intestinal biotransformation. The involvement of biotransformation within the cell monolayer was further supported by experiments at 4°C and the measurement of cell associated chemical concentration. We determined the chemical distribution in all different compartments of this network, which correlated with the logKow. The chamber enabled stable exposure concentrations and close to full recovery at the same exposure time in 50% monolayer with a semi-static exposure using the pipetting robot (1 h interval). Thus, we were able to confirm that any attempt to keep exposure concentrations as constant as possible will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, the pipetting system can be used in a variety of different setups and environments. Because its construction and operation are very cost-effective and do not require any specialized personnel, provisioning of instructions to replicate this design has makes automation technology accessible to a much higher number of laboratories around the world.
promising technology to overcome the disadvantages of traditional sampling techniques with respect to EBM. The first challenge is the demand of water to be enriched which is dependent from the number and extracts consumption of the bioassays used for the assessment. The second challenge is the recovery and carry-over of the potential toxicity from the water sample to the vessels or wells of the bioassay. The third challenge is the representativeness of the sample. The successful implementation of EBM strategies requires the availability of automated sampling devices which allow the sampling of larger water volumes, guarantee the sampling integrity and make it possible to take representative samples over a longer period or during events such as heavy rain- and flood-events. A solution to overcome the disadvantages of classical sampling methods and devices is the recently released LVSPe approach and apparatus. It brings the SPE onshore, allows future maximization of the processing and avoids the transport of larger water volumes to laboratory for filtration and extraction. LVSPe was comprehensively assessed with respect to recovery and carry-over of effects. It has been shown that LVSPe is applicable in monitoring and survey programs, to assess surface water and wastewater with effect-based tools and to unravel one of the causes of mutagenicity in the river Rhine using effect-directed analysis. Thus, LVSPe is a promising technology for the implementation of EBM for water quality monitoring in European and worldwide water quality monitoring. LVSPe is commercially available from MAXX GmbH. However, we declare no conflict of interests as all results presented are scientifically justified.

573 Prioritization of non-target screening suspects based on semi-quantitative concentrations and ToxCast in vitro toxicity data

M. Dingemans, A. Brunner, KWR Watercycle Research Institute; K. Baken, KWR Watercycle Research Institute / CWG; A. van Wezel, Copernicus Institute Utrecht University

In addition to target analyses of chemicals in water samples, non-target analyses are increasingly being applied. The aim of this study was to develop an innovative prioritization tool for chemicals of emerging concern for drinking water, by combining HRMS data with high throughput toxicity data from EPA’s ToxCast database. To increase the health relevance of the prioritization method, both semi-quantitative concentrations (internal standard equivalents) in the water samples (as a measure of exposure) and toxicity classes based on 5th percentile AC_{50} values (as a measure of hazard) were included as these form the basis for health risk assessment. A procedure to collect chemical-specific toxicity data from the ToxCast database and a scoring methodology for detected suspects were developed and applied to different types of water samples (sewage treatment plant effluent, surface water, ground water and drinking water) to prioritize suspects for identification and further risk assessment. ToxCast data were collected from the EPA’s online ToxCast data repository. Assay endpoint AC_{50} values (the concentration at which 50% of the maximum response is achieved) were extracted from the ToxCast database for the tested chemicals (suspects). All ToxCast assays were included in this hypothesis-free analysis. To reduce the impact of very sensitive assay endpoints, the 5th percentile of the range of AC_{50} values of a suspect chemical in ToxCast assays was used as a measure of its toxicity. More than 7000 structures were detected in these water samples by HRMS non-target screening analyses, and these could be linked to >1000 suspects from a curated suspect list of >5000 EU and water relevant chemicals. The ToxCast database contains in vitro effect data for 549 of the 1073 suspects present in the water samples. Many suspects were prioritized based on toxicity and semi-quantitative exposure levels that were not quantitatively estimated based on exceedance of the threshold of Toxicological Concern. After confirmation of their identity, the prioritized suspects are candidates for a in-depth risk assessment based on all available toxicity data, for introduction in monitoring programs or for further risk management measures. Standardization of prioritization schemes for suspect screening approaches may be needed for further introduction of these techniques in water quality regulations. Funded by the Joint Research Program of the Dutch water companies (BTO, project 400554-214).

From detection to action: advancements in assessing and managing highly fluorinated compounds

574 Toward the Comprehensive Profiling of Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl Substances in Firefighting Foam Impacted Soils

G. Munoz, Université de Montréal / Chemistry; P. Ray, Université Pierre et Marie Curie; S. Vo Duy, Université de Montréal / Chemistry; T. Do, Université de Montréal; S. Monroy, McGill University / Civil Engineering and Applied Mechanics; J. Liu, McGill University / Department of Civil Engineering; S. Sauvé, Université de Montréal / Chemistry

In recent years, the comprehensive analysis of both aqueous film forming foam (AFFF) formulations and environmental samples aided to reveal the identities of novel classes of perfluoroalkyl and polyfluoroalkyl substances (PFASs). Following the deployment of firefighting training activities or fire emergency response, the soil is typically the first environmental compartment impacted. In such samples, newly identified PFASs could surpass the concentrations of legacy PFASs by orders of magnitude, indicating the need for in-depth characterization of their transport potential and effects in ecosystems. The methods currently available for the analysis of perfluorooalkyl acids (such as PFOs or PFOA) could, however, seriously underperform for certain newly-identified PFASs. Severe discrepancies were noted as regards the extraction efficiency of cationic and zwitterionic PFASs between soils of variable textural class and organic matter (OM) content, which might be compensated through isotopic dilution to the lack of matching internal standards. If consistent in-situ method recovery cannot be ensured in a set of environmental samples of variable physicochemical characteristics, any comparison drawn between samples (e.g., inter-site differences) could be questionable. Failure to obtain quantitative recoveries from soils/sediments could also preclude a reliable assessment of environmental fate properties (e.g., AFFF-normalizing coefficients, soil/water bioaccumulation factor). Given the aforementioned limitations, the present study set out to propose a suitable preparation procedure for the multi-residue analysis of PFASs in AFFF-impacted soils. A total of 89 PFASs, representing >20 distinct chemical classes previously discovered in AFFF formulations or across AFFF-impacted sites, was therefore evaluated. Multiple extraction methods were assayed to recover PFASs from AFFF-affected soils and PFASs have been assessed in-house with AFFFS and aged. The optimized method presented quantitative or near-quantitative PFAS recoveries from diverse soils and limited matrix effects were noted. The method was applied to a limited survey of firefighting training areas in eastern Canada, showing the prevalence of betaine-based (e.g., 6:2 FTAB, 9:1:2 FTB) and amine-based (e.g., PFHxSxA) PFASs at such sites.

575 Investigation of perfluoroalkyl and polyfluoroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination

R. Janssens, Hochschule Fresenius, University of Applied Sciences; S. Lebertz, SGs Institute Fresenius Utrecht; P.T. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology

Perfluoroalkyl and polyfluoroalkyl substances (PFASs) have been widely studied in environment, outdoor clothes and fire fighting foams. As a consequence of the hazardous environmental properties of some PFASs, such as persistence, bioaccumulation and toxicity, their fate has been widely discussed. Due to their water, dirt and moisture repellent properties, PFASs are suitable for a variety of applications and possess a lot of possible entry pathways that were identified in prior studies. Although, advertisement and material safety data sheets indicate a rather extensive use of PFASs in building materials and industrial textiles, only few studies dealt with investigation of these materials. A total of 23 samples from products used in building industry and 28 industrial textiles have been investigated in the course of this project. Monitoring covered 29 PFASs with a chain length of C4 to C14, including carboxylic acids, sulfonic acids, sulfonamides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluoralkyl acids were up to 430 µg/kg for highly contaminated samples. FTOHs were even detected in concentrations up to several mg/kg. However, FTOHs need to be further investigated since they may be false positives resulting from the low selectivity of utilized transition for FTOH quantification. In addition to performed investigations, rinse of samples of e.g. buildings should be performed to prove suggested entrance pathways. Furthermore, additional method development has to be performed in order to better illustrate entrance pathways.

576 The growing role of seafood consumption for exposures to legacy PFASs

Evidence in Longitudinal Birth Cohorts from the Faroe Islands

C. Dassuncao, X. Hu, Harvard University; F. Nielsen, University of Southern Denmark; P. Weihe. The Faroese Hospital System / Department of Occupational Medicine and Public Health; P. Grandjean, Harvard University; E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences

Rapid declines in legacy poly- and perfluorooalkyl substances (PFASs) have been reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and thus important for mitigation strategies. To better understand the contributions of 19 PFASs (SFSPASs) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faroe Islands) where pilot whale is part of the traditional diet. Median SFSPAS concentrations in children (ages 5 to 13 years) peaked in 2000 (47.7 ng mL⁻¹) and declined significantly by 14.4% yr⁻¹ to 8.7 ng mL⁻¹ in 2012. Perfluorooacryloyl glycerols (PFACs) with nine or more carbons (C₉-9) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, n=0.72). Toxicokinetic modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfonate: PFOS in 2012), despite a decline in whale consumption in recent years. A previous study reports PFASs in Faroese drinking water were below detection. We thus infer that even in a major seafood consuming population, declines in PFASs exposure after 2000 were achieved by the rapid phase out of PFOS and its precursors in consumer products.

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Membrane-water partition coefficients to aid PFAS risk assessment.
S. Droge, University of Amsterdam/IBED Institute / IBED

Widely varying structures of fluorinated compounds have been detected ubiquitously in humans and the environment. Due to the limited understanding of basic physical-chemical properties of any of these PFASs, risk assessment (RA) models still provide highly uncertain outcomes. Most PFASs are ionogenic, and act as surfactants. As a result, octanol-water partition coefficients (K_{ow}) can not be determined experimentally. Due to the lack of experimental data, QSARs to predict K_{ow} are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant (pK_{a}) of PFASs has proven to be difficult to determine experimentally and is simply unknown for most emerging alternative PFASs. This may lead to high uncertainty on the fraction of ionized and neutral species at a certain environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity” 3. One of the main applications of a K_{ow} value in RA models is to relate a chemical’s "hydrophobicity" to bioaccumulation and toxicity. It is therefore utmost surprising that hardly any data is available on measurements on sorption data to (phospho)lipid, for which assays are readily available and that lack all the concerns about experiments with octanol. Phospholipids are in general the key tissue component to sorbs ionogenic surfactants, and relate directly to baseline toxicity levels and bioaccumulation. The current study evaluates the results of two experimental tools to measure sorption of standard PFAS structures to artificial phospholipid: retention on immobilized phospholipid chromatographic column and solid supported lipid membranes. The current study also evaluated to what extent quantum-chemical software COSMOtherm, which does not require the concentration in marine organisms (as it takes 3D through charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning (K_{ow}) of the ionic perfluor species, and the predictions on pK_{a}. Whereas COSMOtherm accurately predicts K_{ow} for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pK_{a} of alternative PFASs (e.g. Genet et al., 2018). Negative results of the current study were obtained on electrons of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

578 Impacts of ocean circulation on the marine PFOS burden in an era of geographically shifting emissions
C. Wagner, Harvard University / Harvard John A Paulson School of Engineering and Applied Sciences; C. Thackray, Harvard University / School of Engineering and Applied Sciences; X. Zhang, Wisconsin Department of Natural Resources / Great Lakes Laboratory for Air Pollution Control and Resource Reuse, School of the Environment; E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences

Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluorooctane sulfonate (PFOS) in the Stockholm Convention in 2009. The ocean is thought to be the terminal sink for most PFOS releases and contaminants that simply take 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning (K_{ow}) of the ionic perfluor species, and the predictions on pK_{a}. Whereas COSMOtherm accurately predicts K_{ow} for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pK_{a} of alternative PFASs (e.g. Genet et al., 2018). Negative results of the current study were obtained on electrons of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

580 Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment
M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; A. Di Guardo, University of Insurbia / Department of Science and High Technology; T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; M. MacLeod, Stockholm University / Department of Environmental Science and Applied Chemistry

Environmental fate and exposure models are a powerful means to integrate information on chemicals, their partitioning and degradation behaviour, the environmental scenario and the emissions in order to compile a picture of chemical distribution and fluxes in the multimedia environment. A 1995 pioneering book, resulting from a series of workshops among model developers and users, reported the main advantages and identified the needs for research in the field of multimedia fate models. Considerable efforts were devoted to their improvement in the past 25 years and many aspects were refined: the inclusion of nanomaterials among the modelled substances, the development of models at different spatial and temporal scales, the estimation of chemical properties and emission data, the incorporation of additional environmental media and processes, the integration of sensitivity and uncertainty analysis in the simulations, etc. However, some issues are still challenging and require research efforts and attention: the need of methods to estimate partition coefficients for polar and ionizable chemical in the environment, a better description of bioavailability in different environments as well as the requirement of injecting more ecological realism in exposure predictions to account for the diversity of ecosystem types and species. For example, the need to include the soil compartment is becoming more pressing as the number of chemicals taking into account the soil compartment is increasing. A possible solution to these issues is the development of models that include the soil compartment and allow for the simulation of chemical transport and fate in the environment. These models have been developed and are currently being used in various studies and applications, including environmental risk assessment, chemical transport and fate in the environment, and the development of emission scenarios. The implementation of these models requires interdisciplinary collaboration among researchers from different fields, including environmental science, chemistry, and computer science. This is particularly challenging as the models need to be adapted to different environmental conditions and to account for the complexity of the ecosystem. However, the development of these models is an important step towards a better understanding of chemical fate and exposure in the environment, and ultimately towards improving the accuracy of environmental risk assessment.
estimation capability of the model. Alignment of the exposure estimation methods to the scientific developments over the last 20 years. Implement the new module of SimpleTreat (4.0). Exploring how to address site specific assessment by EUSES, like for example within authorisation process. A process has been initiated by ECHA with stakeholders to assess the need for update of EUSES. The kick off for this update process is a workshop with stakeholders which will take place in ECHA, in April 2018. The expected outcome of the workshop is the identification and prioritisation of areas where update is needed (scientifically and IT support/setting). Workshop outcomes planned to be available before May 2018 and will be presented to the wider audience of the SETAC conference.

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Advances in exposure assessment of fertilizers: development of a fertilizer environmental exposure tool and generic exposure scenarios under REACH

L. Della Pietra, Fertilizers Europe; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; R. Puska, Yara Suomi; M. Bjorgman, Yara International ASA; K. Oorts, ARCHE

Fertilizers are considered as formulations and therefore no registration or chemical safety assessment is required under REACH. However, use of the individual constituents needs to be covered in the chemical safety reports (CSR) of the respective substances. Currently, exposure and risk assessment of fertilizer uses is mainly described in a qualitative way because of the lack of appropriate environmental release categories (ERCs) and exposure models. Under the umbrella of Fertilizers Europe and the FARM REACH consortium, the fertilizer sector has developed a fertilizer sector uses map. In addition, four sector specific ERCs (SPERCs) were developed, by grouping similar uses, mainly based upon their physical form and application mode. Next, a Fertilizers Environmental Exposure tool (FEE) tool was developed, since in the standard REACH models for environmental exposure assessment (EUSES, ECETOC TRA, CHESAR), no local scenarios for direct release (e.g. hydrogel) were considered to test the framework pruning through additional exposure assessment. The scheme serves as a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI–nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI–nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. Kah M, Hofmann T. 2014. Environ. Int. 63:224–235. 2. Kookan RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.

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Bioaccessibility of grease thickeners and the implications for REACH risk assessment

R.J. Brown, wca consulting; R. Smith, wca; P. Whitehead, wca consulting; J. Dawick, G. Whale, Shell Health / Risk Science Team; A. Dodos, Eldons; T. Halmans, Shell Global Solutions International / Analytical Department

An intrinsic component of greases are the grease thickeners which include a diverse range of substances including metal soaps, metal-complex soaps and polyureas. These different thickeners impart different technical properties on the final grease. Although individually registered under REACH as isolated substances (i.e. extracted from base oil), grease thickeners are typically manufactured in situ in base oil and seldom exist except within a grease base. Under normal environmental conditions, grease thickeners would be expected to remain within the grease base because of the self-assembling nature of the grease thickening process, unique physicochemical properties (or matrix effects) occur between the grease thickener and the base oil. These interactions are important because, to be effective, the grease thickener matrix has to keep the lubricating base oil entrained. It is proposed that these matrix effects have a significant impact on the bioaccessibility of the grease thickener substances in situ in base oil in comparison to their isolated form. These matrix effects are expected to decrease the bioaccessibility of the grease thickener as it is not available to cross an organism’s cellular membrane. The European REACH Grease Thickeners Consortium (ERGTC) have characterised the bioaccessibility of their grease thickeners by conducting leaching studies based on a Water Available Fraction ("WAF") approach, but using relevant media i.e. deionised water for the environment or synthetic fed state intestinal fluid (FeSSIF – Bioorelevant, Switzerland) to assess exposure route via the gut (human health). Data is presented for different types of thickener substance which shows that most thickeners will not be bioaccessible and therefore, there will be minimal exposure to these substances. As the main form in which grease thickeners are manufactured and used, is entrained in a grease base, it is proposed that a lack of exposure based on low-solubilities and/or bioaccessibility is taken into consideration when registering the substances under REACH. This is a pragmatic approach for a group of substances that have low hazard potential and avoids conducting unnecessary vertebrate animal testing. The ERGTC strategy for registering grease thickeners under REACH, taking into consideration bioaccessibility, will be presented, including proposed "limits for leaching". This approach could be expanded to include other types of similar substances which occur in situ in an inert carrier such as base oil.

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The durability criteria: a pragmatic and sound approach to the exposure assessment of nano-enabled agrochemicals

M. Kah, University of Vienna / Department of Environmental Geosciences; P.S. Koornan, CSIRO / Land and Water

After many years of research and development, nano-enabled agrochemicals are starting to make their way into the market. Evaluating nano-enabled agrochemicals against conventional analogues is essential to assess the new risks and benefits associated with the technology, and this raises a number of issues for regulators. The ecological risk assessment of nano-enabled agrochemicals is likely to differ from that of conventional products and new parameters are needed to allow an adequate evaluation of the new products. The majority of products currently in development consists in nanocarrier systems loaded with a registered AI. For this type of products, a priority for assessment is to establish the time during which the AI remains associated with the nanocarrier, i.e. the "durability" of the AI–nanocarrier complex (1). Koopmann et al. (2) present a series of guiding principles for the regulatory evaluation of environmental risk associated with nano-enabled pesticides, including a conceptual strategy relying on the durability parameter. A group drawn from regulatory agencies, academia, research, and the agrochemicals industry recently offered a perspective on relevant considerations pertaining to the problem formulation phase [3]. A case study (pendimethalin nanoemulsion, nanoemulsion, nanosized hydrogel) was considered to test and the framework pruning through additional exposure assessment. The project has been based upon existing REACH exposure modelling, but is adapted for fertilizer use. The project focuses on the communication between stakeholders from other chemical legislations. In order to improve harmonization and communication within the supply chain, generic exposure scenarios have been developed for a number of micronutrients and SPERC combinations. Collectively, the development of SPERCs, the fertilizers environmental exposure tool and generic exposure scenarios, allow for a systematic review of environmental exposure assessments of fertilizers under the REACH legislation. Further information on the project, including downloads of the FEE tool and SPERC factsheets can be found via www.fertilizersEurope.com.

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Can we model emissions, fate and exposure on a global scale? A case study of PCB 153 in human milk

M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); E. Undeman, Stockholm University / Baltic Sea Centre; F. Kookan, ARCHE, Aquatic Ecology, Evolution and Conservation; R. Puska, Yara Suomi; M. Bjørgan, ITM – Stockholm University / Baltic Sea Centre; E. Undeman, Stockholm University / Baltic Sea Centre; M. MacLeod, ITM – Stockholm University / Department of Environmental Science and Analytical Chemistry

One of the grand challenges of environmental chemistry is to be able to predict human exposure to an environmental contaminant based on its emissions. In this paper we explore how, after decades of excellent research by scores of scientists, we can move up to this challenge with a global scale. PCB 153 is a persistent, hydrophilic and semi-volatile pollutant was chosen as the test chemical. We used physico-chemical properties recommended by Schenker et al. (1) and global historical emissions estimates developed by Breivik and co-workers (2) to drive the global multimedia fate and transport model BEITR Global. (1). The fugacities of PCB 153 in air, water and soil, modeled at a spatial resolution of 3.75° x 3.75°, were re-graded to give the historical fugacity records on the basis of individual countries. These were entered into the bioaccumulation and exposure model ACC-HUMAN, which modeled the concentrations of PCB 153 in fish, meat, dairy products and human milk. (2). The human diet in ACC-HUMAN was parameterized for each country based on the WHO Global Environment Modeling System (GEMS) 108 diets model. The modeled concentrations of PCB 153 in human milk were compared with the concentrations measured in the WHO/UNEP global monitoring program for POPs. (3). The predicted and observed concentrations were highly correlated, with a correlation coefficient of 0.76. For 49 out of 78 data points, the predictions and observations agreed within a factor of 4. The model over-predicted the concentrations in central Europe and under-predicted the concentrations in much of Africa, in particular West Africa. Potential weaknesses identified in the chain of models include an under-prediction of the rate of decrease in PCB concentrations in air since the 1980s and inadequate treatment of food sourcing. (3) We conclude that we have come a long way towards meeting this grand challenge for PCB 153, but there remains room for improvement! References U. Schenker et al. Environ. Sci. Technol., 2005, 39, 8434-8441. K. Breivik et al., Environ. Sci. Technol., 2016, 50, 798-805. M. MacLeod, et al., Environ. Pollut., 2011, 159, 1442–1445. G. Czab and M. S. McLachlan, Environ. Toxicol. Chem., 2004, 23, 2356–2366. https://undatalatalog.org/dataset/gemsof-food-consumption-database M. van den
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

586 Regulatory tools and activities for environmental risk assessment of nanomaterials in ECHA


European Chemicals Agency (ECHA) implements the REACH Regulation (EC No 1907/2006 (Registration, Evaluation and Restriction of Chemicals), the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012), and the Classification, Labelling and Packaging (CLP) Regulation (EC No 1272/2008). Industry and authorities need to fulfill their obligations regarding these regulations also for nanoforms as for any other form of a substance. Nanomaterials are implicitly covered by the substance definition of REACH Regulation 1907/2006 although there are no explicit requirement laying down NM specific obligations. ECHA’s experience has shown that REACH would benefit from nano-specific provisions. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(xi). It states that the approval of an active substance does not cover nanoforms explicitly mentioned (Article 4). ECHA currently performs three types of activities to implement REACH, CLP and BPR regulations and to support these processes aiming at ensuring safe use of nanomaterials (NM): REGULATE: formal processes under regulatory frameworks, whereby ECHA uses the legal instruments available under REACH (substance/dossier evaluation, authorisation and restriction), CLP and BPR, SUPPORT: helpdesk, meetings with stakeholders and with Registries, Nanomaterials Expert Group (NMEG), COMMUNICATE: ECHA Nanomaterials web-site, conferences, workshops, communication throughout the supply chain and in a broader context e.g. EUON and press. This presentation will provide a summary of the multiple actions taken by ECHA to address NM under REACH, CLP and BPR. Dossier and substance evaluation, NMEG, EUON and ECHA’s involvement at OECD level. Communication is currently considering modifying some of the technical provisions in the REACH Annexes. This would allow more efficient efforts towards safe use of NM and decreased uncertainties in the regulatory processes. In addition, ECHA highlights the need for good coverage of standard methods applicable to NM to produce adequate information for regulatory risk assessment.

587 Building a Risk Assessment Framework for Nanomaterials in Canada

M. Sauve, Environment Canada; A. Shahsavaran, Environment and Climate Change Canada

Despite the potential benefits associated with the use of nanomaterials, concerns also exist as to potential environmental and human health risks as a result of environmental exposure to nanomaterials. Canada regulates chemical substances, including nanomaterials, under various regulatory mechanisms. The Canadian Environmental Protection Act, 1999 (CEPA) and the Chemical Management Plan (CMP) are key in safeguarding Canadians and the Canadian environment from potentially harmful substances. Under the CMP, the current activities to address nanomaterials include identifying data needs, developing tailored strategies and approaches, work planning and strengthening collaboration with national and international partners and stakeholders. To support these efforts, Canada is developing a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based RAF will inevitably touch on many issues faced by other countries and regulators. Our communication strategy includes consultation and collaboration with multidisciplinary experts, the public and stakeholders. Online collaboration tools will be used to encourage participation. A national expert panel will be consulted in the spring 2018, and SETAC Europe would be the first attempt to reach out to the international scientific community for support. We hope to use this venue to generate new partnerships and to strengthen existing ones. Critical questions based on the challenges identified by Canada over much more than a decade of regulating new nanomaterials, and by the international scientific community looking at risk assessment challenges for nanomaterials, will be highlighted in this presentation.

588 Inventory of available tools, methods, approaches and best practices on nanomaterials/nanotechnologies

B. Duuren-Stuurnan, TNO, Utrechtseweg 48, 3704 HE Zeist, The Netherlands; s. manzo, ENEA / SSPT-PROTER- B; S. Scalbi, ENEA / UTVALAMB - Technical Unit Model, Methods and Technologies for the Environmental A; P. Reale, ENEA; H. Witters, VITO / Applied Bio & molecular Systems; A. Duschl, PLUS; H. Stockmann-Juvala, FIOH; T. Bereznjak, NRC-WE; A. Fororna, SP

The EC4SafeNano initiative, founded by Horizon 2020 is an ongoing effort to build a European Centre for Risk Management and Safe Innovation in Nanomaterials and Nanotechnologies. EC4SafeNano aims to bridge the gap between scientific knowledge on hazard and risk, and ‘fit-for-purpose’ risk management tools and strategies supported by measurement and control methods. The Centre of European organisations will offer services for Risk Management and Safe Innovation for Nanomaterials & Nanotechnologies. One of the first actions of the project was to develop an inventory of available resources related to nanosafety issues. Indeed, until now, many tools and studies which aim to improve human and environmental nanosafety have been developed by research organizations and EU funded projects. Therefore this inventory have the aim to give a useful overview on tools, methods, standards, standard operating procedures (SOPs), guidance documents and best practices in nanosafety. Quality criteria are included to give users the possibility to select or sort based on their examples. The recommendation that approved the standard (and thereby indirectly the procedures followed to come to a standard), the level of evaluation and validation of the resources or the acceptance of the resource in view of the REACH legislation. During the project and after the duration of the project this overview will be updated when new information or updated versions of resources become available or when new resources are introduced. The overview of available resources will be included in an inventory. This inventory will be published on the EC4SafeNano website. There is a large number of Standards (77) and SOPs (136) that can help the end user to conduct testing on toxicity and eco-toxicity, or measurements in workplaces and environment. One important issue is the scarce number of trainings available only 5. This aspect will be addressed in the EC4SafeNano project by the specific training needs and tools of users. Moreover, the presentation will be useful to find out the main methods of environmental risk and to generate some data. The amount of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered only in 6 out of the 28 included tools, and 4 out of 43 Guidance and Best practices. This shows that, at the moment, aspects such as eco-toxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated.

589 The Application of Ecotoxicological Tools to Safer-by-Design Strategies for Engineered Nanomaterials

A. Barrick, Association Saint Yves / UCO / UBL, Mer molecules et sante; N. Mabrouk, Standard, INERIS / Expertise and assay in ecotoxicology unit; A. Chatel, Catholic University of the West / UBL, Mer Molécules Santé; C. Mouneyrac, Université Catholique de I’ouest / UBL, Mer Molécules Santé

OECD test guidelines using aquatic organisms have been identified as suitable starting points for identifying risk that engineered nanomaterials (ENMs) risk represent for the environment. However, standardized testing (mainly relevant for fluorescent or sensory species) may not adequately characterize the risk and dynamic behavior of ENMs in the environment, in particular for aquatic regions like coastal areas which are the ultimate sink for all land based contaminants. As a result, the addition of less conventional organisms to regulatory protocols can promote the characterization of environmental risk nanomaterials pose. Mytilus species have a long history of being used as sentinel organisms to characterize ecosystem health and can be useful to promote the understanding of environmental risk and emerging contaminants like ENMs pose. This information can be particularly useful for the development of safer-by-design strategies as implementation in risk characterization can promote the identification of which products an industry creates pose the lowest environmental risk. In this context, under project the Horizon 2020 project NanoReg2, the aim of this study was to demonstrate the implementation of a safer-by-design strategy for ENM development. Three carbon nanofibers (CNFs) were provided by an industrial partner in order to characterize the potential environmental risk their products poses. The aim of the study was to compare the original product (GaNF) to a new scaled up production process for the CNF (GATam) as well a graphitized version of the product (GANFg). The study implemented regulatory testing using Daphnia magna and Pseudokirchneriella subcapitata as well as hemoctyes from the marine mussel Mytilus edulis (M. edulis) following in vivo and in vitro testing on subcellular endpoints. The testing strategy was conducted in order to demonstrate the suitability of both regulatory testing (OECD tests) as well an in vitro screening strategy on M. edulis hemocytes to characterize the environmental risk posed by ENMs in the context of safer-by-design and its application to industry. In addition, recommendation and discussion on protocols used to test this CNF are provided.

590 Minimising the risk posed by TiO2 nanomaterials used in sunscreen throughout the entire product lifecycle

D. Aix-Marseille Université; J. Houbad, Helioscence; V. Bartolomei, S. Motellier, CEA Liten; D. Boutry, CEA - Grenoble; L. Hedouin, CNRS CRIJOBE; C. Santana, CNRS/CEA/Aix-Marseille Université / Bioscience and biotechnology Institute of Aix Marseille; P. Hennebert, INERIS; A. Pinois, IBIM CNR Palermo; S. Lehmann, University of Grenoble Alps; J. Labille, CNRS Sunscreens are of emerging concern regarding both human and environmental health. While TiO2 nanoparticles used as UV-blockers may offer a safer alternative to organic filters, their fate and impact and resulting regulation are still under consideration, largely related to the potential risk of nanotechnology-based products. After leaving the skin either through bathing or cleaning, the TiO2...
nanomaterials contained in the sunscreen can be released into rivers, lakes, sea shores, and/or sewage treatment plants. Their fate and impact in these different systems is largely determined by the surface properties, i.e. the coating type and lifetime. This project aims to develop the eco-design of sunscreens through the minimization of risks associated with nanomaterials incorporated into the formulation. All stages of the cream life cycle must be considered in this light, from its manufacture to its end of life, through its use by the consumer and its impact on the environment. By considering each development stage of the sunscreen, from the choice of UV-blocker and its integration into a cosmetic formulation, to the knowledge of the risk involved in this choice along the product lifecycle, an eco-design approach can be achieved and risk can be minimized. The present work combines industrial companies specialising in cosmetic formulation with academic research experts in the fields of exposure, toxicity and lifestyle assessment. Sunscreen fabrication, risk for the consumer by dermal exposure, risk for the direct aquatic environment and risk related to the end of life of the product are as many key steps of the sunscreen lifecycle that were investigated in this project.

591 Environmental risk assessment of engineered nano-SiO2, nano iron oxides, nano-CeO2, nano-Al2O3, and quantum dots

B. Nowack, EMPA; Y. Wang, Empa Swiss Federal Laboratories for Materials Science and Technology

Many research studies have aimed to investigate the ecotoxicological hazards of engineered nanomaterials (ENMs). However, little is known regarding the actual environmental risks of ENMs, combining both hazard and exposure data. The aim of this study is to quantify the environmental risks for nano-Al2O3, nano-SiO2, nano iron oxides, nano-CeO2, and quantum dots by comparing the predicted environmental concentrations (PEC) with the predicted no effect concentrations (PNEC). The PEC values of these five ENMs in fresh waters in 2020 for northern Europe and southeastern Europe were taken from a published dynamic probabilistic material flow analysis model. PNEC values were calculated using probabilistic species sensitivity distribution (PSSD). The order of the PNEC values was quantum dots > nano-CeO2 > nano iron oxides > nano-Al2O3 > nano-SiO2. The risks posed by these five ENMs were demonstrated to be in the reverse order: nano-Al2O3 > nano-SiO2 > nano iron oxides > nano-CeO2 > quantum dots. However, all risk characterization values are four to eight orders of magnitude lower than one and no risk was therefore predicted for any of the investigated ENMs at the estimated release level in 2020. Compared to static models, the dynamic material flow model allowed us to use PEC values based on a more complex parameterization, considering a dynamic input over time and time-dependent release of ENMs. The PSSD approach makes it possible to include all available data to estimate hazards of ENMs by considering the whole range of variability between studies and material types. The risk assessment approach is therefore able to handle the uncertainty and variability associated with the collected data. The results of the current study are able to provide a scientific foundation for risk-based regulatory decisions of the investigated ENMs.

592 Occurrence of cyanotoxins in Greek lakes

A. Kosmadaki, National Center for Scientific Research / Institute of Nanoscience and Nanotechnology; S. Zervou, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; K. Manolidi, NCSR Demokritos; T.M. Triantias, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL

Cyanotoxins (CTs) produced from cyanobacteria in surface water during harmful algal blooms can pose significant threat to human health and the environment. Their occurrence or potential associated risks. This research provides the authors thank CYANOCOST – COST Action ES 1105 www.cyanocost.net

593 Interactions between cyanobacteria and daphnia

G. Bojadzija, UMR CNRS EcoBio; M. Bormans, UMR CNRS EcoBio / UMR EcoBio; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phycotoxines / Unité DYNECO / Dept. ODE; C. Wiegand, Université de Rennes 1 / UMR CNRS ECOBIO

Thanks to their adaptation cyanobacteria can cause marine, marine and terrestrial ecosystems. Eutrophication of waters has promoted and will increase cyanobacteria blooms in future, posing hazards to the aquatic ecosystem and human health due to the capability of cyanobacteria to produce bioactive or toxic compounds. One of the groups firstly affected by cyanobacteria is planktivorous zooplankton, such as Daphnia. On the other hand, Daphnia can also suppress cyanobacterial population up to certain density and toxicity. A development of tolerance apparently enables them to withstand cyanobacterial compounds, and is transmissible to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet fully been elucidated, neither has the question, if the presence of zooplankton grazers could modify their production. This study investigates the mutual two-way interactions, in terms of biochemical and life trait responses of both, cyanobacteria and daphnia. Microcystis aeruginosa PCC7806 and M. antirita PCC7806 cultures were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 μm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10⁶ cells/mL, reduced feeding and survival, moreover altered detoxication and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mic- are currently in progress. Vice versa, M. antirita PCC7806 reacted to spent medium from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogenperoxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.

594 Teratogenic retinoid-like compounds produced by cyanobacteria into surface water

K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; E. Sychrova, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment; M. Kraus, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; A. Jonas, Masaryk University, RECETOX / Faculty of Science; J. Priebojová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment; B. Kocábková, Masaryk University, Faculty of Science, RECETOX; J. Večerková, Masaryk University, Faculty of Science, RECETOX; L. Sehnal, Masaryk University Faculty of Science RECETOX / RECETOX Research centre for toxic compounds in the environment; T. Procházka, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / RECETOX centre for toxic compounds from the environment; S. Scholz, Helmholtz Centre for Environmental Research / Department Biocatolic Ecotoxicology; M. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research centre for Toxic Compounds in the Environment

One of the biggest worldwide problems in aquatic ecosystems is the formation of cyanobacterial water blooms that can have adverse effects on organisms. It has been well recognized that cyanobacteria are able to produce diverse groups of toxins. Recent reports show evidence of new toxic products of cyanobacterial metabolism-retinoid compounds, but there is very limited knowledge regarding to their producers, occurrence or potential associated risks. This research provides environmentally significant information about total retinoid-like activity in the biomass of cyanobacterial water blooms as well as in their surrounding water. It documents production of compounds with this bioactivity into the surface water by various cyanobacterial species. The level of retinoid-like activity reaches values that can cause adverse developmental effects in exposed organisms. Retinoid-like activity in cyanobacterial exudates was in a very good agreement with

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595 (Co-)Production Dynamics of Cyanobacterial Peptides

R. Sanchez Natunni, E. Vonwy, Eawag Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry; E.M. Janssen, Eawag Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry

Cyanobacterial algal blooms are expanding temporally and spatially, which is promoted by eutrophication and likely climate change. Cyanobacteria can produce a wide range of bioactive compounds with different modes of action, including various cyanopeptides. Information on the formation and production dynamics of the majority of novel cyanopeptides is mostly unknown even for common cyanobacterial strains. Such information is crucial to assess the risk of these emerging natural toxins for human health in evaluating their potential to reach drinking water supply plants. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides other than microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides from common cyanobacterial species including Microcystis aeruginosa and Anabaena flos-aquae strains. Batch culturing was done under varied environmental conditions and the cell abundance was followed by optical density, cell counting, and biomass was simultaneously determined to determine the rates. The production of cyanopeptide production was followed. Therefore, biomass extracts were purified and measured by liquid chromatography, high resolution mass spectrometry with refined analytical protocols. Comprehensive data analysis was performed to identify cyanopeptides and follow their abundance. These new insights of co-production dynamics are critical to better understand which peptides and peptide mixtures are present during cyanobacterial bloom events.


There are limited methods for the analyses of multiple algal toxins in aquatic food webs, phytoplankton, zooplankton, periphyton, macroinvertebrates, forage fish, bottom feeders and top carnivore fish. Algal toxins in freshwater systems do not necessarily occur as single contaminants; mixtures of toxins may be produced simultaneously from Cyanobacteria, Prymnesium parvum (Prymnesiophyta), and Euglena sanguinea, including microcystins, saxitoxins, cylindrospermopsin, anatoxin-a, prymnesin, and euglenophycin. The objective of the first phase of this research was to spike ex vivo homogenates of fish and forage fish with known concentrations of microcystins (LR, LA and RR) individually and as mixtures, and to develop a method for their recovery and measurement using the MMPB derivatization method. The second phase of the project is to field-test this method on fish collected from water bodies experiencing algal blooms and compare results with individual congener measurements. Extraction methods and analytical methods being developed for this research will also be utilized for development and validation procedures for plankton, periphyton, and macroinvertebrates. Ten and 100 mg of fish homogenates from fish containing 1, 4 and 14% lipids were spiked with 40 and 40 ng of each of the microcystin congeners, LR, LA and RR. Various extraction techniques and conditions were tested to optimize recovery and simplify the procedure. Overall, total toxin recoveries were found to range from 30 to 50%. The lipid content was found to not interfere with generation of MMPB; however, it did impact the workup/extraction procedure in ways which were accountable through the use of a surrogate standard. The MMPB technique can be reliably employed for microcystin quantification in fish tissue. Detections in non-spiked samples (10-20 ug/kg) are comparable to literature precedent. For tissue quantification the MMPB method provides considerable improvements over extraction of individual toxin congeners and is consistent even with very polar or hydrophobic MCs.

597 Saponins in the aquatic environment: hydroylisis and toxicity. X. Jiang, University of Copenhagen; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; B.W. Strobel, University of Copenhagen / Plant and Environmental Sciences; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

Saponins are a class of bioactive natural compounds. Due to their detergent-like structure, saponins have a lot of applications, e.g. as biopesticides in crop protection. They may lead into the aquatic environment due to their low-octanol/water partition coefficient and poor binding to organic matter. They may therefore pose a risk to the aquatic organisms. However, their fate and toxicity in the environment are not fully understood. Hence, we aim to investigate the pH and temperature dependence of saponins hydroylisis together with their dissipation in sampled lake waters and to determine the aquatic toxicity of saponins from quillaja bark, tea seed coat, and quinoa seed coat towards different aquatic organisms. The hydrolysis of saponin (quillaja saponin) was shown to be a highly pH dependent base-catalyzed reaction. The half-life was about 330 ±220 days at pH 5.1 and 26 °C, while decreased to 0.06 ±0.01 at pH 10.0. The hydrolysis was also influenced by an activation energy of 56.9 ±14.2 kJ/mol at pH 7.2. Lake waters with pH varying between 6.4 and 8.2 showed completely different hydrolysis patterns, with a fast initial dissipation of up to 60% of the initial saponin concentration, followed by an extremely slow to nil reaction, making saponin partially persistent in lake waters. The maximal concentrations protecting 95% of the aquatic species (HC) derived from the SSD’s of saponins from quillaja bark, tea seed coat, and quinoa seed coat were 2.91 ±0.00, 0.22 ±0.11 and 22.9 ±5.84 mg/L, respectively. The 100-fold difference in toxicity between the saponin-rich extracts from different plant species indicate that saponin toxicity depends on the species where it origins from, making “read-across” between saponins a dubious exercise. In addition, the predicted environmental concentrations of different saponins are close to or higher than their water quality standard, which means that the saponins might pose a risk to the aquatic environment if not used cautiously. Therefore, we recommend not using surrogate or expected data/conclusion in the regulation of saponin-rich plant extracts and pay more attention to the potential risk of saponins to the aquatic environment.

Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach

598 Setting the Stage to Advance the Adverse Outcome Pathway Framework through Horizon Scanning C. LaLong, U.S. EPA / Mid Continent Ecology Division; G.T. Ankley, U.S. EPA / National Health and Environmental Effects Research Laboratory; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; D. Knapen, University of Antwerp / Zeafrasilhab Dept Veterinary Sciences; S. Munn, European Commission; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory; D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; M. Whelan, University of leicester / Geography; C. Willett, the Humane Society of the United States / Animal Research Issues; X. Zhang, Nanjing University / Environmental Science; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Recognizing the international interest surrounding the adverse outcome pathway framework, which captures existing information describing causal linkages between a molecular initiating event through levels of biological organization to an adverse outcome of regulatory significance, an effort was undertaken to provide the scientific community the opportunity to engage in determining the direction of the AOP framework. Specifically, a horizon scanning effort was used to solicit questions from the international scientific community asking participants to propose questions that consider key outstanding challenges and/or limitations that must be overcome to advance the AOP framework for both research and regulatory decision making. From March-June, 2016, 340 valid questions were collected from 158 global submissions, spanning all continents, to an online horizon scanning survey. Respondents to the survey self-identified as 35% academia, 35% government, 26% industry, and 4% environmental organizations. Following question solicitation, questions were separated into broad topic areas including, AOP networks, quantitative AOPs, collaboration and communication on AOPs, AOP discovery and development, extrapolation, exposure/toxicokinetics considerations, and AOP application. An expert-ranking exercise was then conducted to identify high-priority questions for each category and from this, four key themes emerged including further AOP research and regulatory initiatives. These themes were used as workgroup topics for a Pellston™ Workshop, including: AOP networks and their applications; quantitative AOPs and
their applications; regulatory use of the AOP framework, and expanding awareness of, involvement in; and acceptance of AOPs to support aspects of predictive toxicity and regulatory decision-making. Charge questions for each workgroup were directly modified from those submitted during horizon scanning. Additionally, from the horizon scanning exercise, frequently asked questions (FAQs) were identified and addressed by experts in the field. Together the horizon scanning, expert ranking exercise, and standing FAQs are used to set the stage for the SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway Concept: An International Horizon Scanning Approach,” that took place in Cornwall, Canada during April 2017. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

599 Adverse Outcome Pathway networks: development, analytics and applications
D. Knapp, University of Antwerp / Zebrafish Dept Veterinary Sciences; M. Angrish, US EPA; National Center for Environmental Assessment; M.C. Fortin, Alcami / Environmental and Occupational Health Sciences Institute; I. Katsiadaki, CEfas / Environmental and Animal Health; M. Leonard, BOREAL SA; L. Argiotta-Casaluci, Brunel University London / Institute of Environment, Health and Societies; S. Munn, European Commission; J. O’Brien, Environment and Climate Change Canada / National Wildlife Research Centre; N. Pollesch, US EPA / ORD NHEERL; Mid Continent Ecology Division; L. Smith, University of Florida / Physiological Sciences; X. Zhang, Nanjing University / Environmental Science; D. Crawford, U.S. EPA / National Health and Environmental Effects Research Laboratory

Adverse outcome pathways (AOPs) are an important framework that can help support more effective use of mechanistic, pathway-based, data in risk assessment and regulatory decision-making. AOPs have rapidly evolved from a conceptual paradigm into a formalized framework for organizing biological and toxicological knowledge across diverse domains and continuously in response to the recognized need to continue advancing the framework, SETAC sponsored a global horizon scanning exercise to identify major outstanding topics and challenges related to the AOP framework and its application. The development of guidance related to AOP network development and analysis was identified as a critical need. This report describes the expert ranking exercise, and answers to FAQs, on AOP networks, but also on related topics such as mixture toxicity assessment and the implementation of feedback loops within the AOP framework. This presentation briefly outlines critical concepts concerning the development of AOP networks, how they may be analyzed, and illustrates how information derived from them can be applied. First, derivation of AOP networks is considered in the context of how it differs from development of individual AOPs. Next, the application of filters and layers is discussed, which can be used to refine and enrich derived AOP networks so that they may be tailored to address specific questions of interest. We then introduce a number of analytical and computational approaches that may be used to characterize and analyze the structure of AOP networks to derive information that can guide research and regulatory decision-making. A number of application case studies is used to illustrate concepts underlying development and analysis of AOP networks, and how those concepts tie in with ultimate application. The contents of this presentation represent the personal opinions of the authors and neither constitute, nor necessarily reflect the policies or viewpoints of their employers or institutes.

600 Building and Applying Quantitative Adverse Outcome Pathway Models for Chemical Hazard and Risk Assessment
S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; R. Ashauer, University of York / Environment; R. Connolly, US EPA RTP; B. Landesmann, JRC / Environment; C. Mackay, Unilever; C. Murphy, Michigan State University / Department of Fisheries and Wildlife; N. Pollesch, US EPA / ORD NHEERL; Mid Continent Ecology Division; J. Wheeler, Dow Agrosciences; A. Zapanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory Quantitative prediction and assessment of hazards and risks of chemicals. The adverse outcome pathway (AOP) concept and knowledge base can be used to develop quantitative models (qAOPs) to predict and assess hazards and risks of chemicals. Quantitative models can be developed with a clear problem definition and using AOPs as initial data inputs. Modelling methods range from semi-quantitative to quantitative modeling approaches or combination of these (e.g. fully mechanistic mathematical /ordinary differential equation based, individual-based models, statistical, or Bayesian network models). We discuss best practices for choosing modeling approaches, model building and the necessity for transparent and comprehensive documentation in order to gain confidence in the use of a model. Finally, we present examples of how qAOP models can support decision making: a screening level assessment of the health hazards of chemicals and chemical mixtures using a qAOP Bayesian network model of steatosis, the use of qAOPs in a prospective risk assessment context (e.g. in vitro to in vivo extrapolation using aromatase inhibition as an example) and for extrapolation between species or life stages.

601 Use of Adverse Outcome Pathways to Inform Decisions on Chemical Innovation, Regulation & Stewardship
J. Hill, US EPA NHEERL Integrated System Toxicology Division; P. Browne, OECD / OSCP; K.K. Coady, The Dow Chemical Company / Toxicology Environmental Research and Consulting; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); T. Hutchinson, School of Biological Sciences, Plymouth University / School of Biological Sciences; E. Lienala, OECD; L. Maslankiewicz, National Institute for Public Health and the Environment (RIVM); T.M. Steeger, U.S. EPA / Office of Chemical Safety and Pollution Prevention

An invited group of scientists participated in a SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway Concept – An International Horizon Scanning Approach,” in April 2017. The workshop addressed key challenges or limitations of AOP constructs as tools for informing research and regulatory decisions that were identified by responses to a global Horizon Scanning survey. This presentation will summarize the findings of Pellston Workshop 3, which was tasked with the explication of practical considerations for this use of AOP constructs in regulatory decision making. The use of AOPs and related concepts have increased in scientific and regulatory sectors over the past decade, coinciding with pressures to find innovative solutions to evaluate chemical safety in an efficient manner that better directs resource utilization. This workshop focused on how AOPs can be a useful tool for chemical decision makers in the government and private sector. At the various points where chemical decision making is employed across the “life” of a chemical – from research and development within the commercial sector, government registration and regulation, through to post-marketing use/stewardship – AOPs can be used as an organizing principle. Pragmatic evidence is provided for how AOPs can be and are currently being used in chemical decision-making processes. Considerations for evaluating the suitability of AOP for decision makers are discussed, recognizing that the acceptable level of uncertainty varies based upon the nature of the decision and the context in which it is being applied. The presentation provides multiple examples of AOP use and practical considerations for evaluating whether use of AOPs is fit-for-purpose in different circumstances. This abstract does not necessarily represent the views or policies of the U.S. EPA.

602 Ensuring Long-Term Utility of the AOP Framework and Knowledge for Future Stakeholders
G.T. Ankley, U.S. EPA / National Health and Environmental Effects Research Laboratory; A. Carusi, University of Sheffield; H. Davies, WA State Dept of Health / Dept of Ecology; G. De Grandis, Norwegian University of Science and Technology; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; G. Hodges, Unilever Research / Safety and Environmental Assurance; K. Lee, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; M. Whelan, University of Leicester / Geography; C. Willett, the Humane Society of the United States / Animal Research Issues

The adverse outcome pathway (AOP) framework serves as a knowledge assembly and communication tool to facilitate translation of mechanistic (e.g., molecular, biological, histological) data into adverse apical outcomes meaningful to chemical risk assessment. Although initially designed for ecotoxicology applications, the framework has also received extensive attention relative to chemical safety assessments for human health. Moreover, as the AOP concept and associated knowledgebases have evolved, it has become recognized that the potential stakeholder community is broader than scientists and regulators directly involved in chemical safety assessment. For example, the application of AOP-based thinking for addressing biomedical challenges has become increasingly evident. This presentation will identify various stakeholders who currently, or could potentially, benefit from application of the AOP framework and knowledge to specific needs, and describes challenges and strategies to effectively engage these stakeholders. We also present a “roadmap” on how to maintain a viable, sustainable network to support AOP stakeholders, including recommendations for governance and coordination of AOP development and knowledge dissemination in a multi-stakeholder consortium. The contents of this abstract neither constitute, nor necessarily reflect, official USEPA policy.

603 Adverse Outcome Pathways: Moving from a scientific concept to a globally accepted framework
M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; C. LaLone, U.S. EPA / Mid Continent Ecology Division

The adverse outcome pathway (AOP) framework has gained significant international traction as a systematic approach for capturing existing knowledge to transparently link mechanistic data to apical toxicity endpoints as a means to inform research and risk assessment. While the framework has evolved significantly since...
its introduction in 2010, it was recognized that a survey of the broader scientific community would be useful in identifying shortcomings and in guiding future initiatives. In 2016, we reached out to national and international scientific and regulatory communities to collect questions and provide an opportunity to discuss key outstanding challenges that must be addressed in order to realize the full potential of the AOP framework. Four key themes emerged from this “Horizon Scanning” exercise (see presentation “Advancing the Adverse Outcome Pathway Framework – An International Horizon Scanning Approach” in this session), which were then addressed at a Society of Environmental Toxicology & Chemistry (SETAC) Pesticide Workshop comprised of international participants representing industry, government, academia, and NGOs was held in Cornwall, Ontario, in April 2017. This presentation will provide an overview of the overall outcomes and common themes that emerged during this Pesticide Workshop. In brief, common themes that spanned across these main topics included the need to simplify, translate, and better communicate the AOP framework to the broader international stakeholder community, and a consensus that the AOP framework does not represent a rigid tool but rather a knowledge repository for diverse stakeholders ranging from epidemiologists to mainstream experimental toxicologists to policy makers and managers. Furthermore, while considering the AOP framework and its applications, the field of environmental toxicology and human health naturally merged into a continuum that is at the nexus of Toxicology in the 21st century. In particular, it was felt that the current momentum the AOP framework has gained across a wide range of professional sectors provides the unique window of opportunity to reach out to and gain acceptance of this framework by society, which will be required for it to become an integral part of the international chemical and environmental risk assessment landscape. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

Environmental specimen banks in research and regulation for a better environmental quality

604 Monitoring of POPs in the Swedish aquatic ecosystem and in human milk

E. Nyberg, A. Bignert, S. Danielsson, Swedish Museum of Natural History; C. Ek, Department of Applied Environmental Science / Department of applied environmental science.

In the 1960s, the Baltic Sea was found to be severely polluted by persistent organic pollutants (POPs). These discoveries were the starting point of a continuous Swedish national monitoring program for contaminants in biological matrices, mainly from the marine and freshwater environment, with samples dated as far back in time as 1969. Today’s marine and freshwater monitoring programs consist of 32 lakes and 28 marine sites where matrices as perch, pike, arctic char, herrings, cod, eelpout, blue mussel and egg from guillemot, oystercatcher and common tern are annually collected. In 1967, examination of human exposure to POPs was initiated by Karolinska Institutet in Stockholm through measurements in human milk from the area, and since 2007 milk has also been collected from Gothenburg in the southwest of Sweden. The milk samples were in 1997 transferred to the Environmental Specimen Bank at the Swedish Museum.

The main objectives of the monitoring program are to investigate changes over time, to estimate geographical differences and to assess compliances with set target values. Moreover, the program is designed to answer these different questions with a high statistical power. Since the start of the monitoring, concentrations of PCBs, DDTs, HCHs and HCB have decreased in fish and bird eggs from both the Baltic Sea and the Swedish freshwater environment. Several of the classical POPs have also decreased considerably in human milk. However, the non-linear trends differ between the monitoring matrices for several contaminants. In some cases the peak differs, and in others, concentration is levelling out for one matrix but continues to decrease for another. In addition, the concentrations of PCBs, DDTs and HCHs are, despite continuous decreases since the 1970s, still higher in the Baltic Sea compared to, for example, the North Sea.

605 Jumping out of the frying pan and into the fire? Spatial and temporal trends for PBDEs, Dechlorane Plus and alternative flame retardants in samples of the German environmental specimen bank


In the last century, conventional brominated flame retardants (FRs) such as polybrominated diphenyl ethers (PBDEs) were identified as persistent organic pollutants and subsequently regulated. Novel or alternative FRs were introduced as their replacements to meet ongoing market demands. Many of these alternative FRs are also highly chlorinated or brominated and their fate and effects in the environment may be similar to those of their regulated counterparts. Until now there are only few comprehensive data sets about alternative FRs in the environment, particularly for Germany. In order to provide for a systematic overview about the current state of contamination of the German environment to FRs, a large set of terrestrial, freshwater and marine samples from the German environmental specimen bank were analysed for 45 FRs (PBDEs, Dechlorane Plus and brominated aromatics, brominated ethers, cyclic BF Rs). The substances will be discussed with respect to their spatial occurrence in the environment (including different matrices as well as land use and ecosystem types), their substance patterns in the environment and their accumulation over time going back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree leaves and tree deer will be used to illustrate time trends for regulated flame retardants and their substitutes. Recommendations will be given to European and international chemical management.

606 New Uses of Archived Specimens from the U.S.A. NIST Marine Environmental Specimen Bank


The National Institute of Standards and Technology (NIST) has been involved in the long-term archival of biological and environmental specimens for over 40 years. Specimens originally intended for monitoring geographic and temporal trends in emerging contaminants as well as changes in transport and accumulation of legacy contaminants have added value today. Tissue and fluid specimens from marine animals, including mammals, seabirds, sea turtles, bivalves, fish, coral and coral ecosystems, collected through various projects are archived at the Marine Ecosystem Specimen Bank (MBS) at the National Institute of Standards and Technology in Charleston, South Carolina, USA, using standardized protocols for collecting, processing, and cryogenic storage. The protocols ensure a high quality sample is provided for downstream analysis that is fit-for-purpose and that homogeneous aliquots are uniform, reproducible, and stable over time. New investigations exploring if the standardized protocols, 1) affect the quality and suitability of RNA for gene expression studies, and 2) are feasible to implement for taking specimens in concentrations of perfluorinated alkyl acids (PFAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-capacity well-screened genome, and 2) the discovery of using total mercury as an alternate method to genetic species identification, have also been conducted and will be discussed.

607 Monitoring of the indoor environment of ESB laboratories with selected target and non-target screening methods

P. Bohlin Nizzetto, Norwegian Institute for Air Research; M. Schlabach, A. Halse, P. Rostkowski, NILU Norwegian Institute for Air Research.

The environmental specimen banks (ESBs) handle and store a wide range of high-quality samples with a main objective to perform retrospective analyses of newly identified contaminants (chemicals of emerging concern, CECs). It is of highest importance that the ESBs serve to maintain a high environmental and not contaminated during handling and storage. Strict quality assurance (QA) protocols are applied at the individual ESBs, including specially dedicated laboratories, no use of personal-care products, cleaning routines and more. More complicated to control is the indoor air and dust in the laboratories and storage locations. Building materials and indoor objects may contain and further enhance the release CECs to the indoor environment. To evaluate trending trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-capacity well-screened genome, and 2) the discovery of using total mercury as an alternate method to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research

J. Astrin, Zoological Research Museum Alexander Koenig

Within their genomes, the organisms on our planet contain an immense wealth of information about the diversity of life. These genomes conserve the code to identify organisms, comprehend population structures, etc. Fast progress in molecular technologies dramatically speeds up research on genetic biodiversity and increases the demand for professionally preserved and managed genome-quality samples in many disciplines, e.g. in ecology, conservation biology, etc. Biodiversity biobanks cater specifically to these demands, and in a standardized way. Environmental samples collected periodically by ESBs following defined routines constitute a very valuable source of DNA for biodiversity research, as they keep open a window that allows the parallel, correlative analysis of the chemical and of the species community composition of a given environment over time. Through species
Assessing health risks associated with organic micropollutants in drinking water is an innovative combination of in vivo and in vitro assays and analytical platforms performed on-shore close to Vatsfjorden (Norway). Several metals, NORMs and organic pollutants are monitored as part of the activity. Effect data for the monitored compounds were compiled from various databases and literature. The Tier 1 identified a cumulative environmental risk of the stressors, and several metals and organics had a risk quotient above 1 (preliminary data). The potential for a cumulative environmental risk was verified in Tier 2 where species group specific risk was investigated. Metals were identified as the main risk drivers for algae, crustaceans and fish, where fish was identified as the most sensitive species group for this exposure scenario. Based on the used exposure scenario, compiled effect data and the suggested approach for ERA of multiple stressors, a potential environmental risk was observed. The main challenges and uncertainties for the proposed approach are linked to exposure data in terms of speciation and bioavailability; time consuming and subjective effect data compilation and assumption of additivity of ionizing radiation and chemical stressors. The approach for estimating environmental risk of multiple stressors requires validation through experimental studies, but could already serve as a suitable tool for prioritization of stressors and organisms of concern, and to identify knowledge-gaps in terms of exposure and effect data. Acknowledgements: The project was funded from NRC project 223268 (CERAD) and in-kind from Norwegian Institute for Water Research (NIVA).

Ecotoxicity testing of environmentally realistic contaminant mixtures using passive samplers: what can we learn from repeating toxicity tests over an extended period of time? J. Brown, Norwegian Radiation Protection Authority; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

In current environmental risk assessment, researchers assess effects caused by single substances to single species and extrapolate for realistic conditions where organisms are usually exposed to complex contaminant mixtures. The use of passive sampling opens new possibilities to work with such mixtures and to transfer them into biotest systems by either applying passive dosing (for equilibrium based samplers) or extract spiking (for integrative samplers). Our research objective was to investigate whether or not environmentally realistic contaminant mixtures...
(ERCs) have effects on marine phytoplankton and how effects could be explained by measured contaminant concentrations. Further we looked at the repeatability of our test results over an extended time period of 16 months. In the presented research we used extracts of Speedisk™ passive samplers deployed in and outside of the harbour of Zeeland (Netherlands) and observed statistically significant (p<0.05) growth stimulation of up to 6.4 ± 0.5 % and 11 ± 2 % (in the harbour) and 7.0 ± 0.5 % and 14 ± 3 % (outside of the harbour) after an extract storage time of 0 and 8 months, respectively. After 16 months the previously observed effects disappeared completely. In order to explain the differing ecotoxicological responses a targeted approach was used to identify the contributions of metal contamination and (bio)chemical composition to the observed effects, and whether the effects were due to individual contaminants or interactions between them. The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be on the identification of key parameters influencing toxicity in different groups of species in order to derive conceptual models allowing the extrapolation from the lab towards the field situation.

615 Marine Diatom Exposure to a Complex Mixtures of Fourteen Chemical Pollutants at Environmental Concentrations. What did we learn? D. Napierska, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; R. Carvalho, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; I. Sanseverino, European Commission Joint Research Centre; S. Balzano, M. Potalivo, ISPRA Institute for Environmental Protection and Research; R. Loos, European Commission Joint Research Centre; D. Maron, T. Letteri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Thousands different chemicals are discharged into the environment from agriculture, industry, medical facilities, house-holds. Currently, there is an increasing concern for the environmental impact of mixture of compounds since the additive and eventual synergistic effects are unknown and could produce serious adverse effects. To address this issue, a joint effort of 16 European and associated research groups participated to an exercise to test a 14-substance synthetic reference mixture at safety environmental concentration under the Water Framework Directive (Environmental Quality Standard, EQS). The mixture, was tested on the own routine bioassays to investigate the chemical mixtures effects (Carvalho et al., 2014). The bioassays covered the entire ecosystem from bacteria to fish as well in vitro assays providing an unique scenario from ecological risk assessment perspective. The results showed that effects were observed at very low concentration on algals/bacteria composition in a marine microcosm, immobilization in crustacean, fish embryo toxicity and frog embryo development. Transcriptomics analysis was performed for the marine diatom Thalassiosira pseudonana exposed either to single compound or the mixture to investigate whether the single exposure and multiple exposure would show different gene expression profile pattern. The results show that the mixture induces a pattern similar to the ones induced by the single herbicides Duron and Isoproturon. Signatures induced by the Cadmium or Nickel partially overlapped with the mixture signature. The exposure to the other compounds did in general not induce relevant signatures, although a weak overall consistent signature is present for some of them. In conclusion the effects of the mixtures could be explained mainly by the exposure to the two herbicides.

616 How protective is the current risk assessment for soil invertebrates? P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; J. Roembke, ECT Ektotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natał da Mata, University of Lisbon / Department of Life Sciences; V. Lessa, University of Coimbra; S. Chelinho, CFE Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; N. Capela, CFE Centre for Functional Ecology; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products

The present risk assessment evaluating effects from plant protection products (PPP) as well as other chemicals towards soil organisms encloses uncertainties. According to the current guidance on terrestrial ecotoxicology, the risk assessment for soil organisms exposed to PPP is based, in a first step, on results of standardised tests performed in artificial soil. This substrate is a mix of sand, peat, kaolinite clay and calcium carbonate and is not comparable to natural soils. However, limited data is available on the degree to which soil parameters influence the toxicity of chemicals for soil invertebrates in field soils, since toxicity is modulated by chemical sorption and bioavailability. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms. These uncertainties in the accuracy of the lab to field extrapolation of PPP effect on soil invertebrates and other soil organisms are based on the underestimation of the toxicity of test chemicals for soil organisms in natural soils. A screening project has been initiated in spring 2016, comprising a literature review aiming to investigate the effects of soil properties on the impact of PPP’s on soil organisms. The practical part of the project included laboratory studies on Eisenia sp. and Folsomia sp. on 4 PPP in 5 different soils. The results showed deviations on toxicity values obtained for single substances in different soils up to factor 6.4. The highest differences were detected for Folsomia sp, exposed to the active substance Pendimethalin in OECD10% and Lafa 2.1, respectively. So, the current risk assessment schemes for soil organisms based on standard laboratory studies performed with the surrogate species Eisenia sp. as well as Folsomia sp. is not always protective. Uncertainties in the assessment do exist regarding the effects of chemicals in natural soils towards other soil organisms, and other varying soil parameters that have not been investigated systematically so far (e.g. pH, clay content and interaction between them). The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be on the identification of key parameters influencing toxicity in different groups of species in order to derive conceptual models allowing the extrapolation from the lab towards the field situation.

617 Risk assessment of soil organisms in field: dealing with earthworm community Y. Bayona, P. Brulle, ANSES, Seq. ENV; A. Bouzin, ANSES, Seq. ENV; F. Guerin, Joint Protection Project; PPP Joint laboratory risk assessment for soil organisms followed the Tiered Approach procedure. It covers worst-case situations (i.e conservative estimates and toxicity laboratory studies) to the most realistic assessment (i.e. Field studies). The recent EFSA opinion proposed a framework for risk assessment of soil organisms and definition of protection goals. Still, no statistical tool was proposed when dealing with field studies as higher tier. The aim of this communication is to test tools routinely used for regulatory risk assessment of communities. The tools for the ecological communities were mostly developed for aquatic organisms risk assessment. The multivariate analysis (PRC) is used for the community comparison. Individual populations are compared date-by-date using various statistical analysis commonly including Dunnett test and Wilcoxon signed-r test. The main disadvantage of these tests is the low number of replicates which could lead to false negative or false positive. The recently improved Minimum Detectable Difference is used to assess the robustness of the data used in these statistical tests. Then, through the analysis of results, we propose some lead and improvements for the soil community risk assessment, from the experimental design to the sampling choice and statistical analysis in the context of higher tier regulatory risk assessment of chemicals for earthworm and soil communities.

618 Metal soil threshold calculator tool: use of available data for derivation of metal soil quality standards for different scenarios and protection goals K. Oorts, ARCHE; I. Schoeters, R. Tasselli, European Commission  Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

During the last 2 decades, intensive research has been performed to improve the risk assessment of metals in soil and numerous chronic metal toxicity data were generated for various terrestrial species and microbial functions in different soil types. Models were developed for correction for differences in bioavailability among soils and for differences between laboratory and field conditions. For many metals, the large amount of chronic toxicity data for different species and functions allow the application of the species sensitivity distribution approach (SSD) to derive soil quality standards. This work was mainly triggered by the European legislation on chemical management (REACH) and the data were therefore primarily used to derive threshold values for the highest tiers of the Population-No-Effect Concentrations (PNEC) for this specific risk assessment. To facilitate a more flexible derivation of ecological quality standards for metals in soil for different protection goals (e.g. remediation thresholds), jurisdictions, regions or sites, while still making maximal use of the wealth of data and models already available, a metal soil threshold calculator tool has been developed. This freely available spreadsheet reports almost 1200 reliable toxicity data for the most direct effects of the metals Cd, Co, Cu, Pb, Ni, Mo and Zn to soil organisms (plants, invertebrates and microbial processes) and calculates ecotoxicological threshold concentrations expressed as (pseudo-)tota1 (i.e. aqua-regia extractable) metal concentrations in soil (mg/kg dry weight). All metals covered have sufficient chronic toxicity data allowing the derivation of an SSD. The soils used for ecotoxicity testing cover for each metal a wide range of soil properties, making the results representative for most regions in the world. Several optional tools are included to allow calculation of metal soil threshold concentrations for various goals (e.g. risk assessment or setting of remediation thresholds for different land uses): selection of organism groups or species to be considered, selection of

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effect levels from the original dose-response curves (ECs), selection of protection level (probability level in SSD), bioavailability models to be included etc. The advantages of this approach are the maximal use of available toxicity data and bioavailability corrections and the enhanced transparency in the derivation of ecological quality standards for metals in soil for different goals and different scenarios.

619 Assessment of pesticides on a landscape level - What is basically needed? A. Toschki, Research Institute gaiac; M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research

It is currently discussed and is widely accepted that species diversity and habitat quality dramatically decreased in the last decades due to the increasing intensity of agricultural land use. The decline was proved for various species groups, such as soil arthropods, insects, butterflies, birds etc. With the loss of species also a variety of benefits and ecosystem services that were provided by the species dropped away. The intensive use of pesticides in agriculture is responsible as a whole. In current risk assessment procedures, single pesticides were authorized individually independent of the current status of biodiversity in the field and possible effects of the combined or sequential use. Additionally there is no treatment of exemption of the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and thresholds for the life operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.

620 Potential new soil test requirements for the risk assessment of pesticides in the European Union: do we have the right methods? J. Roembke, ECT Oleotekologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

In February 2013, the European Food and Safety Authority (EFSA) published a Scientific Opinion entitled “Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms”. This document summarizes various scientific issues relevant for the risk assessment of plant protection products (PPPs) for in-soil organisms, i.e. micro-organisms and invertebrates (plants are covered in another EFSA document). The aim of this document is to provide a tool for the future monitoring of the use of pesticides in soil ecotoxicology, but – more importantly – it also summarizes the scientific background for a new approach. In the future, soil risk assessment should be based on the ecosystem service approach, meaning that important services at agricultural landscapes (e.g. nutrient cycling, soil structure maintenance, just to name a few) have to be protected. In consequence, protection goals for soil organism communities, i.e. their biodiversity and functions relevant for providing these services, have to be defined. This contribution will focus on one important question, assuming that the new risk assessment approach is put in practice: Do we have the appropriate (e.g., scientifically sound, robust, standardized) methods to cover the new data requirements? In this contribution we focus on four aspects of the new methodology: Organism groups, endpoints, soils, regions (i.e. agricultural practices are not covered). In fact, there are various research needs which have to be addressed asap, i.e. before the new requirements will be put in practice. We focus our discussion on those test systems which are already standardized (or which are in the process of being standardized in the foreseeable future). Besides OECD also methods published by ISO or national organisations such as Environment Canada are considered, knowing that the latter often have to be adapted in order to cover the specific needs of PPP environmental risk assessment schemes. In addition, the same criteria as in other comparable approaches will be used and examples of suitable methods will be given. Most important is whether they can be modified in a way that they are useful under the upcoming EFSA regulations.

621 Poster spotlight: TH154, TH155, TH156

Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking

Wood-fibres composite in substitution of a synthetic material to enhance sustainability purposes for automotive sector S. Maltese, Magneti Marelli Spa / Powertain Division; a. bonoli, DICAM- Alma Mater Studiorum - University of Bologna / DICAM; L. Zanchi, M. Delogu, University of Florence / Department of Industrial Engineering Nowadays bio-composite materials have increased automotive market penetration, which intend is to produce environmental friendly products while maintaining their competitive edge [1]. In particular wood-fibers is considered a more environmental friendly alternative to the synthetic reinforcements as talcum, glass and carbon fibers. The reason behind is due to their less impact on production issues (sharp reduction of toxic and fossil materials as well as for the energy expenditure, light-weight profile and more energy credit through their incorporation [2-4]. This study presents the application of a newly engineered wood-based product, called Woodforce®, for the production of an automotive PedalBox Support (PBS); in particular, the environmental advantages/disadvantages are presented and discussed when such material is thought to substitute the glass fibres. At this scope, a comparative environmental analysis has been performed between two materials – a standard material (with glass-fibres content) and an innovative (with woodchip content) – which perform the same function. 1. Reference sample German. 2. Tasman A., Curus M. 2016. Wood and natural fiber composites current trend in consumer goods and automotive parts. Reinforced Plastics 60: (3) 170–173. [2] Joshi S.V., Drzał L.T., Mohanty A.K., Arora S. 2003. Are natural fiber composites environmentally superior to glass fiber reinforced composites? Composites: Part A 35 (2004) 371–376. [3] Boland S. Claire, De Kleine R., Keoleian G.A., Lee E.C., Kim H.C. Woodforce® an industrially based New material; T.J. 2015. Life Cycle Assessment of Woodforce®. [4] Holbery J., Houston D. 2006. Natural-Fiber-Reinforced Polymer Composites in Automotive Applications. Low-Cost Composites in Vehicle Manufacture.

623 Resource depletion of a Lithium ion battery cell technology M. Cusenza, Università degli Studi di Palermo; S. Bobba, G.A. Blengini, Politecnico di Torino; M. Cellura, M. Mistretta, University of Palermo Lithium-ion batteries (LIBs) are the dominating storage technology for electric vehicles (EVs). Different types of LIBs, using diverse cathode and anode materials, are used worldwide. A new trend in automotive industry is the use of natural fibers as reinforcements. This study presents the application of a new industrially engineered natural fiber reinforced composite material available in the market, such as LiMnO₂, Li(Ni₀.₅Co₀.₅Mnₓ)O₂. The cathodes contain a wide range of raw materials (RMs), among which e.g. cobalt is in the 2017 list of CRMs for the Europe Union (EU). CRMs are both of high economic importance for the EU, and vulnerable to supply security. In the last years, the increasing demand of LIBs has triggered a growing interest in the need to ensure the security and the sustainability of the critical raw materials used in LIBs and in general in EVs. In this context, lithium rich layered oxides from the class xLiMnO₂(1− x)LiₓMnO₂ are considered a more environmentally friendly alternative to the synthetic reinforcements as talcum, glass and carbon fibers. The reason behind is due to their less impact on production issues (sharp reduction of toxic and fossil materials as well as for the energy expenditure, light-weight profile and more energy credit through their incorporation [2-4]. This study presents the application of a newly engineered wood-based product, called Woodforce®, for the production of an automotive PedalBox Support (PBS); in particular, the environmental advantages/disadvantages are presented and discussed when such material is thought to substitute the glass fibres. At this scope, a comparative environmental analysis has been performed between two materials – a standard material (with glass-fibres content) and an innovative (with woodchip content) – which perform the same function. 1. Reference sample German. 2. Tasman A., Curus M. 2016. Wood and natural fiber composites current trend in consumer goods and automotive parts. Reinforced Plastics 60: (3) 170–173. [2] Joshi S.V., Drzał L.T., Mohanty A.K., Arora S. 2003. Are natural fiber composites environmentally superior to glass fiber reinforced composites? Composites: Part A 35 (2004) 371–376. [3] Boland S. Claire, De Kleine R., Keoleian G.A., Lee E.C., Kim H.C. Woodforce® an industrially based New material; T.J. 2015. Life Cycle Assessment of Woodforce®. [4] Holbery J., Houston D. 2006. Natural-Fiber-Reinforced Polymer Composites in Automotive Applications. Low-Cost Composites in Vehicle Manufacture.

624 Analysing the environmental impacts of alternative solutions for passenger transportation: LCA of a charging station for e-bicycles G. Ballesteros, University of Roma Tre / Department of Business Studies; R. Salomone, L. Giuttari, G. Saija, G. Ioppolo, University of Messina / Department of Economics; M.C. Lucchetti, University of Roma Tre / Department of Business Studies

The transport sector causes environmental impacts that are mainly connected to the passenger car activities. In this context, strategies for reducing the environmental impacts related to the transport sector are required by moving from cars to alternative transport vehicles, such as electric bicycles. Although many studies have been focused on the application of the Life Cycle Assessment (LCA) method for assessing the environmental impacts of electric vehicles (EVs), there are...
few information regarding the environmental impacts connected to the life cycle of the charging infrastructures to operate the EVs, and, in particular, regarding the environmental performance of charging station for e-bicycles. This study aims to evaluate, through the application of the LCA method, the environmental burdens of a stand-alone charging station for electric bicycles manufactured in Italy, assuming its installation and utilization in Italy with a lifetime of 15 years. The investigated stand-alone charging station is composed of eight designated positions for charging the e-bicycles’ battery and of two wind-solar modular systems that are respectively equipped with one photovoltaic (PV) module and three low profile vertical axis wind turbines. The structure is also geared with a system connected to the conventional electricity grid which allows to provide energy when the wind and solar conditions are insufficient. The analysis also includes the whole life cycle of each e-bicycle, assessing the potential avoided production of conventional electricity which may be replaced by the electricity surplus produced by the wind-solar-system. The functional unit (FU) adopted to perform the analysis is one charging station installed in Italy and used for a lifetime of 15 years. System boundaries follows a cradle-to-grave approach and include four main phases: 1) production phase, 2) installation phase, 3) use and maintenance phase, and 4) end of life phase. The main environmental impacts are due to the production phase and, in particular, are connected to the production of the e-bicycles, while higher environmental benefits are connected to the replacement of conventional electricity with the energy surplus produced by the wind-solar modular system installed on the charging station.

625 Raw materials requirements scenarios for the electric mobility penetration in the Italian urban vehicle fleet: a life cycle thinking approach combined with raw materials assessment

L. Cutai, C. Chadwick, P. Porta, ENEA; M. La Monica, C. Scaglirano, CINIGeo The automotive fleet is gradually changing from internal combustion to hybrid and electric engines. This is fostered by the European policies concerning the need of reduction in pollutant emissions and in the improving of urban air quality. Currently most of the analyses carried out focus on the comparison of the emissions related to the different typologies of cars and on the CO₂ emission cut generated by the consumption of electricity produced from renewable sources in the use phase of the car. The proposed approach wants to investigate the need of raw materials in future scenarios of electric technology penetration in the urban vehicle fleet. Focusing on the Italian urban vehicle situation and considering the current technology used for the electric batteries and the recharging systems, the study account for the raw materials needed for electric vehicles penetration scenarios of the electric mobility adopting a Life Cycle Thinking perspective. The authors have been beyond a mere quantification of the primary materials required for the progressive electrification of the urban fleet, evaluating the raw materials availability from a market perspective and defining the limiting factor among three basic material of the current electric technologies (lithium, graphite and manganese). Therefore this work, starting from an evaluation of the material needed for different electric mobility penetration scenarios in the Italian urban fleet, wants to highlight the market dynamics especially for 3 primary materials widely required in the electric mobility focusing also on the possibility offered by a transition to a circular economy, investigating the green mining potential available for these materials both for their recovering in the same technology and in others fields.

626 Coupling dynamic carbon accounting and partial-equilibrium economic model for energy policy assessment

A. Albers, P. Collet, D. Lorne, IFPEN / Economics & Technology Intelligence; A. Benoist, CIRAD / UPR BioWooEELBSA research group; A. Hélias, Montpellier SupAgro / IBE ELSA Energy production and consumption is the main driver for anthropogenic GHG emissions, and in the French context, the transportation sector is the principal emitter accounting for almost one third of these emissions. The growing need to reduce GHG emissions and mitigate climate change demands tapping alternative energy resources, as efficiently enforced by energy policies (e.g. the French Transition Plan for Growth Act). LCA scholars increasingly assess the environmental performance of the advance biofuels, but mainly from a static perspective. Results are therefore limited to linear simplifications, whereby long-term impacts might be neglected or underestimated. New dynamic LCA approaches have been suggested, however no consensus is available on how to treat techno-economic carbon accounting scenarios over different timeframes. This study further addresses the temporal shortcomings of bioenergy systems while considering future outlooks and consequences on the market dynamics. The approach consists of a hybrid-approach combining the MIRET energy systems model with dynamic Chio accounting models towards dynamic LCA. The former—a perspective techno-economic partial-equilibrium model covering the French energy-transport sectors—represents scenario-dependent outputs over a long timeframe (2007 to 2050), exploring optimisation options under no-policy and policy-driven constraints. The latter assesses biomass growth and alloometric relations representing the Chio fixation of a vegetation species per hectare on an annual basis, and thus the time-dynamic Chio flows between the atmosphere and the technosphere. The assessed Chio flows primarily originate from lignocellulosic biomass and their co-products generated from MIRET outputs under business as usual and normative scenarios. The transformed Chio inventories are then combined with both dynamic and static LCA characterisation factors, towards a comparison of both approaches. The results show that the time factor is an essential component to properly assess long-term Chio sequestration potentials and climate benefits of lignocellulosic biofuels. The combination of technological innovation and market dynamics in a transitioning energy systems expands the assessment boundaries providing insights into least cost (economic optimisation) and low carbon (Chio sequestration) options influenced by policy and decision constraints. Future refinements addressing other bioenergy paths are envisaged.

627 Poster spotlight: TH304, TH309, TH314

Developments in the use of bioassays for chemical and environmental risk assessment (II)

628 SIMONI: Smart integrated monitoring of the water quality

R. van der Oost, Wateren / Onderzoek en Advies; G. Sileno, Wateren / Research and Development; M. Thao Nguyen, Waterproof; L. Maria, Wateren / Water Systems

At present, regular water quality assessment is almost exclusively performed by target chemical analysis of substances. Scientific research over the last decades, however, demonstrated that water quality assessment with only chemical analyses is not reliable. Since over 100,000 harmful substances may be present in the aquatic environment, a paradigm shift from ‘substances’ to ‘effects’ has to be encouraged in order to implement a more holistic approach in regular monitoring. Therefore, an alternative Smart Integrated Monitoring (SIMONI) strategy has been developed by Dutch water research institutes. The purpose of this 2-tiered strategy is to obtain more reliable information on the chemical water cycle quality without increasing the monitoring efforts. Key factors for generating this model were the selection of the most relevant bioassays and the design of effect-based trigger values (EBT). Tier 1 of the strategy combines micropollutant concentration by passive sampling with testing of 15 biochemical endpoints. This hazard identification makes the distinction between low, acceptable and increased ecological risks. Only at sites where tier 1 indicates increased ecological risks, a customized tier 2 research is performed to identify the chemicals that cause the bioaualytics effects and to evaluate if observed in vitro effects pose a serious in vivo threat to the ecosystem. The present paper is focused on demonstrating the field feasibility of the SIMONI strategy. The strategy has been applied and validated in more than 100 Dutch field studies. Results of several of these monitoring studies will be presented in order to demonstrate the field feasibility of the SIMONI strategy for identifying hotspots of chemical pollution. It is expected that the ecological risks will be generally occurred at agricultural sites. In addition, increased ecological risks were also observed at waters receiving wtp effluents, sewage overflows and landfill runoff. A tier 2 approach is the assessment of the mixture toxic pressure on the ecosystem by using chemical analytical results for msPFAF determination (potentially affected fraction of water organisms due to multiple chemical pollutants). At these sites with increased ecological risks due to micropollutants, similar classifications were obtained with bioanalytical and extensive chemical analyses. The tier 2 research at agricultural greenhouse areas identified eight pesticides contributing most to the increased environmental risks.

629 Bioassay battery responses to POCIS and Speedisk passive sampler extracts

M. de Baat, University of Amsterdam / IBE-FAME; M. Thao Nguyen, Waterproof; R. van der Oost, Wateren / Onderzoek en Advies; W. van den Berg, Waterprof Laboratory, Research and Validation; P. de Voogt, University of Amsterdam / IBED; M. Kraak, University of Amsterdam / IBE-FAME

A large portion of the toxic effects observed in surface waters can not be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. These effects are observed in surface waters not only by exposing a sorbent to the target environment, accumulating compounds from the water over time. Hence, there is an urgent need for a time-integrated effect-based monitoring strategy that employs a combination of passive sampling and bioassays, thus detecting bioanalytical responses caused by mixtures of all bioavailable compounds. Many pollutants of emerging concern are polar compounds, underlining the need to standardize the employment of polar passive samplers in such monitoring strategies. The aim of the present study was, therefore, to determine bioassay battery responses to extracts of two types of polar passive
samples, the often used polar organic chemical integrative sampler (POCIS) and the recently introduced Speedis, POCIS and Speedis passive samples were simultaneously deployed at sites likely to be contaminated with polar compounds, including agricultural greenhouse sites and wastewater treatment plant (WWTP) impacted locations. The extracts of the passive samples were subjected to a battery of bioassays, specifically responsive to polar compounds, including ERu, anti-AR and GR chemical activated luciferase gene expression (CALUX) bioassays, as well as the RIKILT WaterSCAN for antibiotics activity. In addition, the Microtost test for non-specific toxicity to bacteria was run. The two investigated passive sampling devices generated a different toxicity profile in the applied bioassay battery, with several unique responses per passive sampler. Nonetheless, POCIS caused bioassay responses more frequently and more intensely, leading to more frequent trigger values exceeded and thereby to the detection of ecotoxicological risks. Hence, POCIS outperformed Speedis in most bioassays at the majority of the investigated locations. These results thus suggest that POCIS is best fit for application as passive sampling device targeting polar compounds in effect-based water quality monitoring strategies.

630 Endocrine modulation and toxic effects of sunscreen chemicals, Octocrylene and Benzophenone, on zebrafish Q. MENG, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences Sunscreen chemicals are used to prevent the skin and hair of human from the harm of ultraviolet light, and they are widely applied in a variety of personal care products. These materials are discharged to the environment continuously as daily care products. At present, many kinds of UV filters are found in surface water and polluted water, and their concentrations in the urine and blood of human are much higher than that in the environment, indicating that the UV filters have the possibility of bioaccumulation to cause toxic effects in the accumulated organisms. Benzophenone (BP1), benzophenone-3 (BP3), benzocaine, diclofenac and octocrylene (OC) are four such chemicals that have been detected in environmental samples and linked to alterations in estrogen receptor signalling pathways and oxidative stress. In this study, zebrafish larvae and a liver cell model of zebrafish liver cells, the ZFL cell line, will be used to investigate the potential risks of BPs and OC and the molecular mechanism underlying the toxic effects. Docking analyses, 24 h and 96 h chemical exposures will be conducted on the ZFL cells to determine the potential binding affinities to the estrogen receptor (ER) and the half-lethal concentration (LC50) for the UV filter chemicals. The gene expression profiles on the ER pathway and the aryl-hydrocarbon receptor (AhR) pathway will also be measured by quantitative real-time PCR in ZFL and larvae exposed to the sunscreen chemicals. A dual-luciferase reporter gene system with AhR and ER clones transfected in ZFL cells will be used to confirm the biological activities of these sunscreen chemicals in ZFL cells.

631 Current status of in vitro bioassay approach in environmental risk assessment of emerging biotic environmental mixtures and individual organic contaminants M. Machala, Veterinary Research Institute / Chemistry and Toxicology; K. Penčíková, S. Strápová, Veterinary Research Institute, Brno / Chemistry and Toxicology; L. Svrčková, Veterinary Research Institute, Brno / Chemistry and Toxicology; J. Necá, M. Cignañek, Veterinary Research Institute, Brno / Chemistry and Toxicology; I. Bartoková, Z. Dvořák, Faculty of Science, Palacky University, Olomouc / Toxicology; J. Tomek, Institute of Biophysics, CAS, Brno Since 2001, our laboratory has continuously employed an ever growing set of in vitro bioassays combined with a detailed chromatographic analysis, and in some cases the effect-directed analysis, in order to identify principle modes of action of contaminants bound to river sediment, airborne or diesel exhaust particles. Toxicity profiling of selected individual contaminants was used as a complementary approach, which aimed to identify major toxic modes of action and principle contributors to specific toxicity effects. The AhR-mediated activity has been recognized to play a key role in toxicity of organic extracts of abiotic environmental mixtures. Using the DR-CALUX assay, we established relative effective potencies (REPs) of large (up to 1000) polyurethane and polyurea compounds, including PAHs, methyl-, nitro- and oxy-PAHs, thiophanes, diphenylfurans, benzazulenes and carbazoles, which complemented the available data on polychlorinated biphenyls, dibenzo-p-dioxins and dibenzofurans. Recently, we also developed REP values in human AhR-dependent reporter gene assay, in order to compare the potencies in rodent and human models. Using a set of various CALUX assays, responses and selected individual classes of organic contaminants. The general outline of those studies will be illustrated using an example of a detailed in vitro toxicological evaluation of standard reference material of diesel exhaust particles (SRM 2975), with an aim to document both the complexity of the observed effects and the difficulties faced when applying these data in risk assessment of complex mixture. [The study was supported by the Czech Science Foundation, grant no. P503-12-G147.]

632 Hormone-like activities in waste water characterized by CALUX bioassays, Biological analysis and Effect-directed Analysis Y. van Oorschot, R. ten Broek, The Water Laboratory; M. Lamoree, VU University, Department Environment & Health / Department Environment & Health; N. Zwart, VU University Department Environment & Health; C.J. Houtman, The Water Laboratory Emission of compounds with biological activities from waste water treatment plant (WWTP) effluents into receptor systems is a topic of concern for ecology and drinking water companies. We investigated the occurrence of hormone-like activities in WWTP samples and pursued to identify compounds responsible for them. To this aim, CALUX bioassays and a UPLC-qMS target analysis method for hormones used in high volumes in pharmacy were applied. In addition, a novel high throughput Effect-directed Analysis (HT-EDA) platform was used to separate compounds in the extracts with high resolution LC-fractionation creating 288 4.79 sec.-fractions that were tested in the bioassays. In parallel, QToF high resolution MS data were recorded to correlate compound identity to peaks from the ‘bioassay chromatograms’ reconstituted from the bioassayed fractions. All five types of activities tested were observed in the WWTP samples. Androgenic and estrogenic activities were almost completely removed during WW treatment, anti-androgenic and anti-estrogenic activities were observed directly in WWTP effluents and progestagenic, androgenic and anti-androgenic activities were present in similar concentrations in untreated as in treated WW. The glucocorticoid activity in influent was fully explained by prednicarburate, triamcinolone acetonide, dexamethasone and amcinonide. In effluent however, detected hormones could only explain 15% of the activity, indicating the presence of unknown (metaboles of?) glucocorticoids in effluent. The androgenic activity in influent and effluent and estrogenic activity in effluent were only due to the presence of prednicarburate and androstenedione and testosterone. Application of the HT-EDA-platform delivered bioassay chromatograms of the WWTP effluent in which active compounds were separated into sharp peaks. The glucocorticoid activity appeared to be caused by at least four different compounds (peaks), not being dexamethasone. The androgenic activity was fractionated into a small peak probably attributable to co-elution of testosterone and androstenedione. The QToF MS data are currently interpreted to elucidate the identity of the unknown glucocorticoids. Also bioassaychromatograms of other endpoints will be discussed. This study demonstrates the value of toxicity profiling with bioassays as first tier in the monitoring of water quality. In case observed activities exceed trigger values, additional risk assessment is needed and the HT-EFDA platform can help to characterize and ultimately identify the responsible compounds.

633 Non-target screening and identification of emerging pharmaceuticals and their transformation products in wastewaters c.g. Pauws, University of Bordeaux / LPC / LPTC; J. Dévier, University of Bordeaux / EPOC / LPTC; UMR 5805 CNRS; M. Dèvier, University of Bordeaux / EPOC / LPTC; UMR 5805 CNRS; E. Maillot-Maréchal, INERIS / UMR SEBIO ECOT; G. Geneste, University of Bordeaux / EPOC / LPTC; UMR 5805 CNRS; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; H. Budzinski, University of Bordeaux Wastewaters represent a major pathway of introduction of EDCs into the aquatic environment. Considering the university of Bordeaux and its WWTP, the overall contamination diagnostic and to identify major contaminant that could be emitted from the WWTP effluent could predominantly be attributed to the presence of unknown glucocorticoids in effluent. The androgenic activity in influent and effluent and estrogenic activity in effluent were only due to the presence of prednicarburate and androstenedione and testosterone. Application of the HT-EDA-platform delivered bioassay chromatograms of the WWTP effluent in which active compounds were separated into sharp peaks. The glucocorticoid activity appeared to be caused by at least four different compounds (peaks), not being dexamethasone. The androgenic activity was fractionated into a small peak probably attributable to co-elution of testosterone and androstenedione. The QToF MS data are currently interpreted to elucidate the identity of the unknown glucocorticoids. Also bioassaychromatograms of other endpoints will be discussed. This study demonstrates the value of toxicity profiling with bioassays as first tier in the monitoring of water quality. In case observed activities exceed trigger values, additional risk assessment is needed and the HT-EFDA platform can help to characterize and ultimately identify the responsible compounds.
products (e.g. O-desmethyl venlafaxine, O-desmethyl tramadol) were recurrent found. This approach combined to LC-QTOF has allowed establishing a list of systematic detected non-target compounds in several wastewaters.

Indigeneity and Science: A collaborative work in progress

634 The Nechako White Sturgeon Recovery Initiative: A discussion of species at risk conservation, scientific outreach, community and First Nations support

T. Lane, University of Saskatchewan; C. Williamson, Freshwater Fisheries Society of British Columbia; S. Shekhar, University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Nechako white sturgeon (Acipenser transmontanus) are a genetically unique population of fish which have inhabited the Nechako watershed for roughly 10,000 years. Within the last 50 years this population has suffered significantly because of anthropogenic activities. In the Status of Freshwater Fisheries in Canada identified the Nechako white sturgeon as a Nationally Significant Population. In 2006, this population was further listed as endangered under the Species at Risk Act. Prior to both designations in 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed. A 5-million-dollar aquaculture facility, the Nechako White Sturgeon Conservation Centre was designed specifically for the NWSRI, built, and opened in 2014 to provide the resources to further support this conservation effort. This facility was a product of over a decade of work by a Technical Working Group (TWG) and a Community Working Group (CWG). The TWG includes biologists, industry and First Nations members who have a vast knowledge of white sturgeon. The goal of the TWG is to use the best available science, local and traditional knowledge to determine why the Nechako white sturgeon population is declining and to develop a plan to rehabilitate this population of fishes. The CWG is composed of First Nations members, local and regional governments, industry, and public volunteers. The CWG plays a vital role in communication, public outreach, and promoting community involvement. Activities of TWG and CWG support the mandate of the NWSRI through direct involvement of First Nation communities, volunteers and students. The Emergency Sturgeon Live Release Boat Kit program is an example of multiple First Nation communities working in union with the NWSRI to promote conservation and stewardship of Nechako white sturgeon. The annual Juvenile Sturgeon Release event involves students, volunteers and First Nations who release thousands of juvenile sturgeons, which were reared from eggs by the TWG, back into the Nechako watershed. The NWSRI is a unique conservation effort that promotes and utilizes the support of scientists, First Nations, volunteers and students to engage the community in the conservation of an endangered species.

635 The NSERC CREATE H2O Program on First Nations Water and Sanitation Security: Case Studies on Drinking Water Quality

A. Farenhorst, University of Manitoba / Soil Science; W. Ross, University of Manitoba / Centre for Human Rights Research; R. Me, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amarawansa, K. Anderson, University of Manitoba / Department of Soil Science; E. Khafipour, University of Manitoba / Department of Animal Science; A. Kumar, University of Manitoba / Department of Microbiology

The NSERC CREATE H2O program is the first science-engineering research training program in Canada that combines technical water and wastewater management training with Indigenous theory, law and methodological skills training. Since its inaugural year in 2013, the program has trained 86 students who have collectively worked with 30 First Nations communities in the provinces of Manitoba, Ontario and Saskatchewan, Canada. 33% of the university students and postdocs enrolled in the program self-identify as Indigenous. This presentation provides an overview of the approaches the program uses for: engaging communities and students in research training activities, Indigenousizing science and engineering curricula, and designing advocacy strategies to support clean drinking water as a human right in First Nations communities in Canada. Case studies are presented to demonstrate the community-based monitoring programs implemented to examine drinking water quality in First Nations homes. First Nations communities participating in the research had various types of water distribution systems. Overall, water samples were collected from: lakes and groundwater (source water); water treatment plants, water trucks and community standpipes; homes relying on piped water, wells, above-ground cisterns and underground cisterns; and buckets/drums in homes without running water. Water analysis included standard measures of chemical and bacterial parameters, DNA and RNA techniques for microbial profiling, and the quantification of antibiotic-resistance genes in water samples. The main findings are that despite effective water treatment plants in communities, the tap water in many First Nations homes contained fecal bacteria at alarmingly high levels and antibiotic-resistance genes were also detected in a range of drinking water samples. The issue of poor drinking water quality in First Nations communities in Canada remains unsolved and there is an urgent need for improved monitoring and upgrading of infrastructure, especially in communities relying heavily on cisterns and community standpipes for drinking water supplies. Most importantly, investments to connect homes directly to water treatment plants via improved pipelines is key to reducing human exposure to waterborne illnesses, while enhancing options for families to participate in economic development, food security and spiritual and cultural wellbeing in their communities.

636 Rare earth elements (REEs) in the Canadian Subarctic: scientific perspectives and community engagement with environmental monitoring in Nunavik, Northern Quebec

G. A. G. Millian, Centre dédues nordiques, Université de Montréal / Department of Biological Sciences; J. Gérin-Lajoie, Université du Québec a Trois-Rivières / Centre dédues nordiques, Département des sciences de lenvironnement; J. Chetelat, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; E. Hébert-Houle, Université du Québec à Trois-Rivières / Département des sciences de lenvironnement; J. Rowell, University of Montreal / Department of Chemistry; J. Heath, The Arctic Eider Society; H. Snowball, The Northern Village of Kangiqsualujuaq, R. Mickpebag, Sakkuq Landholding Corporation Kuujjuaqapiik; M. Amyot, Universite de Montreal / Département de sciences biologiques

Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and iniquities important on both biotic and abiotic communities for emerging contaminants. The pervasive effects of Indigenous knowledge is the environmental impact of mining, including the large number of rare earth element mining projects that are currently being developed in northern Canada. Rare earth elements (REEs) are a chemically-similar group of contaminants of emerging concern, which includes the 15 trivalent lanthanide metals. Not particularly rare, REEs are increasingly exploited for essential uses in high-tech industries, including electronics, clean energy, and agriculture. Although knowledge of the fate of REEs and their impact on natural ecosystems is critically needed as emissions increase, few ecotoxicological studies exist for REEs particularly field studies on their bioaccumulation and food web dynamics. To investigate how REEs behave in remote northern food webs, samples were collected from community-driven collaborative research projects with the Inuit communities of Kuujjuaq-apiik-Whapmagooosti (K-W) and Kangiqsualujuaq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. We present perspectives from the Indigenous and community engagement: Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and bioamplify in northern food webs? How to best establish a sustainable community-based environmental monitoring program? Can we engage the youth in environmental monitoring and science education? Wildlife harvesting and tissue sampling was partly conducted by local hunters, including a range of key subarctic species important for both biomonitoring and country food. Indigenous knowledge was used in the study design, to coordinate local sampling, and to decide when, where and what species to collect. Our study presents novel data on the behaviour of REEs in northern ecosystems and recommendations for establishing sustainable and effective community-based environmental monitoring projects with indigenous communities for emerging contaminants.

637 Te Ohu Mō Papatūānuku: A Collective Response to Healing

T. Godfrey, H. Híreire, Te Whare Whanga O Awamuaarangi / School of Undergraduate Studies

The use of pentachlorophenol (PCP) as an anti-sapotist in timber treatment, with subsequent disposal of chemically treated wood waste in the Whakatane District of New Zealand has resulted in a legacy of contamination. There are 36 identified wood waste sites located on private and public lands, as well as the customary lands and waters of the indigenous Ngāti Awa people. The pervasive effects of contaminants upon both human and environmental health has led to the formation of the Nechako Wild Recovery Initiative (NWSRI) in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed.

Te Ohu Mō Papatūānuku is a collective response to healing, trauma, and community healing. It is the environmental impact of mining, including the large number of rare earth element mining projects that are currently being developed in northern Canada. Rare earth elements (REEs) are a chemically-similar group of contaminants of emerging concern, which includes the 15 trivalent lanthanide metals. Not particularly rare, REEs are increasingly exploited for essential uses in high-tech industries, including electronics, clean energy, and agriculture. Although knowledge of the fate of REEs and their impact on natural ecosystems is critically needed as emissions increase, few ecotoxicological studies exist for REEs particularly field studies on their bioaccumulation and food web dynamics. To investigate how REEs behave in remote northern food webs, samples were collected from community-driven collaborative research projects with the Inuit communities of Kuujjuaq-apiik-Whapmagooosti (K-W) and Kangiqsualujuaq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. We present perspectives from the Indigenous and community engagement: Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and bioamplify in northern food webs? How to best establish a sustainable community-based environmental monitoring program? Can we engage the youth in environmental monitoring and science education? Wildlife harvesting and tissue sampling was partly conducted by local hunters, including a range of key subarctic species important for both biomonitoring and country food. Indigenous knowledge was used in the study design, to coordinate local sampling, and to decide when, where and what species to collect. Our study presents novel data on the behaviour of REEs in northern ecosystems and recommendations for establishing sustainable and effective community-based environmental monitoring projects with indigenous communities for emerging contaminants.

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whereby science is an integral remedial component and provides a vehicle for remediation to occur, but cultural and soul connections of the indigenous people are the drivers of reciprocal remediation, and subsequent healing. Scientific knowledge applies science and indigenous knowing revitalises relationships, informing and infusing behaviour with an ethos of respect, empathy, and reciprocity.

638 Discussing the Unfamiliar but Contentious: Hydraulic Fracturing Consultation with Remote, Indigenous Communities in the Northern Territory, Australia

R. Smith, Hydrobiology Pty Ltd; R. Pepper, Land and Environment Court of New South Wales; D. Ritchie, Ninti One Foundation

On 18 September 2016 the Northern Territory (NT) Government announced a scientific inquiry into hydraulic fracturing of onshore unconventional reservoirs in the Northern Territory (the Inquiry) under the Inquiries Act (NT). The Inquiry was required to assess the available scientific evidence to determine the likely nature and extent of the environmental impacts and risks, including cumulative impacts and risks, associated with hydraulic fracturing of unconventional reservoirs and the Associated Activities in the NT. The Inquiry was specifically instructed to assess whether or not there would be unacceptable impacts or risks to economic, cultural and social conditions, by developing and implementing a stakeholder engagement program. Indigenous people make up most of the resident populations in the areas of the shale-gas basins in the Northern Territory. Indigenous people are linked with their land (including waterbodies) by their ancient traditions and continue to be the custodians of their land in accordance with those traditions. As a community, they must be able to maintain their cultural traditions relating to that land in order that their ownership rights continue to be recognised, from one generation to the next. Indigenous communities are therefore particularly vulnerable to degradation of the landscape and the natural systems it supports. Therefore, the Inquiry undertook focused stakeholder consultation with remote indigenous communities in the NT through a series of visits in remote communities and forums and hearings. These could not be conducted in the same manner as larger community consultation, and featured language and background knowledge barriers that are not typical of even remote non-indigenous community consultation in Australia. A number of these issues, and how they were addressed are discussed. Although the timeframe allotted to the Inquiry was particularly challenging for indigenous community consultation, and hence the extent of engagement in the process varied greatly between communities, nonetheless the Inquiry did achieve substantial engagement with most. The community feedback gained thereby was a vital input into the Inquiry’s assessment of the potential cultural impacts of shale gas development in the NT.

639 Incorporating cultural values and perspectives of First Peoples’ (Aboriginal) People into water planning, science and environmental water management

B.J. Moggridge, Institute for Applied Ecology, University of Canberra / Institute of Applied Ecology

Australia is the driest inhabited continent on Earth, yet is has been the traditional lands of its original inhabitants Australia’s First Peoples for thousands of generations. Protecting water landscapes (surface and ground water) has always been a high priority for survival in a dry landscape, and protecting water remains a cultural obligation. The challenge for First Peoples is to ensure their value and relationship with water is not diminished or excluded by modern day water planning and science or from the environmental flow management. First Peoples acquire the right wisdom and traditional science and knowledge and many indicate that their worldview is seeing water as inseparable from the land and the sky, bound by traditional lore and customs for its protection. For Australia’s First Peoples, occupying an ever drying landscape, traditional knowledge of finding, re-finding and protecting water sites has been integral to their survival for so long. This paper will explore relationships between First Peoples and water planning and environmental water management in three ways. Firstly, history, challenges and institutional responses in integrating First Peoples cultural values into water planning, science and management. Secondly, propose a series of on-the-ground applications of cultural water and environmental water empirically. Finally, integrating First Peoples’ science into water management will be assessed through comparisons between the Australian situation through case studies looking at models and methodologies.

Improvements in environmental exposure assessment: Development and application of tools across industry sectors, regulatory agencies, and international boundaries (II)

640 Tap water intake of poly- and perfluoralkyl substances (PFASs) in relation to serum concentrations in a nationwide prospective cohort of U.S. women

X. Hu, F. Laden, Q. Sun, P. Grandjean, Harvard University; L.W. Yeung, University of Oeobro / Department of Chemistry; E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences

Drinking water advisory levels have been adopted by many regulatory agencies to reduce chronic exposure to persistent fluorochemicals. However, most U.S. advisory levels are based on the assumption of approximately 20% of overall PFAS intake comes from drinking water. Better characterizing the relative importance of drinking water to overall human exposures is important for developing health protective guidelines. Most previous investigations that have associated drinking water PFAS exposures and total body burdens of these compounds have focused on highly contaminated sites. Exposure to PFASs for the general population of individuals from geographically diverse areas are thus less understood. Here we investigate the relative importance of drinking water for total PFAS exposure among women in the Nurses’ Health Study (NHS), a large U.S. based cohort study. Our analysis included U.S. women who provided a residential drinking water sample in 1989-1990. We measured concentrations of 11 PFASs in a subset (n=1052) of archived drinking water samples and serum samples. We evaluated the relative importance of home tap water for measured levels of PFASs in human using both statistical and toxicokinetics (TK) models. Results suggest that home tap water is a significant exposure source for general American women. In 1989-1990, the median contribution of drinking water to serum PFASs in women in the NHS cohort was 8.8% to 30% for the five PFASs modelled. This ratio varies across individuals and is affected by up to a factor of 2-3. We will present measures to assess how this ratio varies geospatially and whether it is associated with distance to well-known point sources. The spatial analysis results will also be discussed in the presentation. By comparing PFAS concentrations in archived tap water sample with recent tap water samples matched on the township, we found the fraction of quantifiable PFASs (i.e. known PFASs) has decreased in most towns and unknown extractable organic fluorine (EOF) has increased. Our analysis suggests tap water may be a significant exposure source for five PFASs across a group of U.S. women from diverse geographical areas. Increases in unquantified EOF in recent tap water suggest additional quantification would be worthwhile. Other exposure sources such as consumer products are suspected to dominate overall exposure of individuals in the NHS cohort prior to the restrictions and regulations of legacy PFASs in the U.S.

641 Consideration of the bioavailability of metals and metal compounds in freshwaters in regulatory frameworks

H. Steudel, Fraunhofer IME Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; C. Díaz Muñiz, Cantabrian Basin Authority; H. Garelick, Middlesex University; N. Kandile, Ain Shams University / Department of Chemistry, Faculty of Women; B.W. Miller, US Environmental Protection Agency / National Enforcement Investigations Center; L. Pantoja, Middlesex University / Natural sciences; W. Peijnenburg, RIVM / Center for Safety of Chemicals and Products; R. Pepper, Land and Environment Court of New South Wales; P. Van Sprang, ARCHE; M.G. Vijver, CML Leiden University / Conservation Biology; J. Vink, DELTARES / Dept Soil and Groundwater systems

Recent research has demonstrated that both total and dissolved metal concentrations are not the most appropriate parameters for the risk assessment of metals in aquatic systems. There is an increasing awareness by leading regulatory bodies in the USA, Europe and other countries that the bioavailable fractions of metals could be better descriptors of their risks. The principal concept of metal bioavailability is the Biotic Ligand Model (BLM) which allows site-specific assessments of metals’ risks by considering the environmental factors which determine the bioavailability of dissolved metals in the aquatic environment. For many metals bioavailability in freshwaters is modulated by dissolved organic carbon (DOC) concentrations, water hardness, the pH of the water and other factors such as temperature, concentrations of further ions and suspended solids as well as metal speciation. Metal-specific BLMs were proposed for different biological species and both, acute and chronic exposures. The BLM approach has been described extensively in the scientific literature, and BLMs have been applied for the risk assessment of metals and metal compounds (e.g., for copper and zinc in the EU). In the past, the broader use of the BLM approach for the site-specific evaluation of surface water monitoring data was hampered by the huge data requirements of the original BLMs (several site-specific water parameters). But the recent development of user-friendly BLM-based bioavailability tools e.g., BLM4 (www.Bio-met.net, www.PNEC-pro.com) now allows the consideration of bioavailability for the evaluation of freshwater monitoring data of relevant metals. Such tools, which only need a basic set of easily available water parameters as input (mostly pH, Ca concentration, DOC, and dissolved metal concentration), are currently available for metals such as lead, nickel, copper and zinc. The new EU Water Framework environmental quality standards for lead and nickel according to Directive 2003/39/EU now consider the bioavailable fractions of these metals. In this contribution, the advantages and possible drawbacks of BLM-based bioavailability tools are presented highlighting feasibility, ranges of validity, and comparability between tools. Finally, recommendations for the regulatory implementation are given. This contribution is based on the outcome of the IUPAC-supported project “Consideration of bioavailability of metals/metal compounds in the aquatic environment” (#2011-060-1600).
Age-Based and Time Trends of Exposure Chemical Biomarkers in the US Population 1999-2014

V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Environmental Health Sciences; J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Environmental Health Sciences; O. Jolliet, University of Michigan

When interpreting biomonitoring data, we are limited by the cross-sectional nature of biomonitoring data and incomplete longitudinal data. It is important to differentiate between the potential influential of temporal determinants on legacy exposure, versus current exposure that may be due to relevant consumer product use, etc. In addition, an overarching systematic approach to studying legacy exposure for a broad set of chemicals is missing. We developed a method to evaluate and compare age-specific exposure trends for 229 chemicals in the US population. Chemical biomarker measurements and demographic traits were obtained from the National Health and Nutrition Examination Survey (NHANES) datasets for the years 1999-2014 (n = 74,942). We extracted the persistence of chemical biomarkers from 16 different classes of chemicals from databases, literature, and qualitative data. We used Quantitative Structure Activity Relationships (QSAR) when needed. To compare differences in chemical biomarker concentrations across the age groups, we partitioned the distribution of each chemical biomarker by 12 different age groups, which were defined based on age-specific behaviors. To evaluate the influence of age on the chemical exposure biomarker concentrations, we performed a series of biomarkers that have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism's responses to pollutant exposure. Therefore, this project was initiated to support the implementation of the WFD biota monitoring by comparative investigations and to provide a basis for the establishment of WFD biota monitoring requirements (e.g., compliance testing for human health and secondary poisoning of wildlife-based EQS, comparability of monitoring data between sites and trend monitoring). To this end a dedicated sampling campaign was designed which covered six different freshwater sites. Fish were caught at sampling sites in the rivers Weser, Havel, Elbe and Moselle, in Lake Starberg and a lagoon at the Baltic Sea for each of these fish species were sampled that are listed in a German guidance document (RAKON IV.3): bream, chub, perch, roach and whitefish. During each sampling campaign it was tried to obtain twenty fish per species from two different age classes allowing multiple comparisons. Fish were dissected into fillets and carcasses, which were processed separately. Biometric data (e.g. fish size, weight, sex) were documented. Age was determined by eye in decades, but the legacy of these exposure processes remains apparent in northern Canadian landscapes today. From 1948-2004 Giant Mine operated 5 km north of the City of Yellowknife, and contributed to the economic growth of one of Canada’s largest northern cities. Giant Mine roasted arsenopyrite ore at high temperatures to liberate gold, however a by-product of this roasting process was over 20,000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. Which life stages are most appropriate? Which age/size class is appropriate? Which tissue should be chosen? Fish of which trophic level should be caught? In this contribution, influences of these factors on fish levels of PS (e.g., mercury, PFOS, HCB, HBCDD) will be evaluated. It will also be assessed whether the data allow deriving factors for the conversion of whole body to fillet monitoring data and vice versa. Another aspect is to test whether the normalization of biota monitoring data (e.g., lipid normalization, trophic level normalization) enhances comparability.

464 Using Paleoecoecology to Assess the Toxicity of Lake Sediments Impacted by Legacy Gold Mining in Yellowknife, NT, Canada

C. Cheney, University of Ottawa / Biology; M.P. Pothier, J.R. Thiennpoint, University of Ottawa / Department of Biology; J.B. Korosi, York University / Department of Geography; L.E. Kimpe, University of Ottawa / Department of Biology; J.M. Blais, University of Ottawa / Biology

Natural resource extraction has supported the development of Canada’s far north for many decades, but the legacy of these extraction processes remains apparent in northern Canadian landscapes today. From 1948-2004 Giant Mine operated 5 km north of the City of Yellowknife, and contributed to the economic growth of one of Canada’s largest northern cities. Giant Mine roasted arsenopyrite ore at high temperatures to liberate gold, however a by-product of this roasting process was over 20,000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. Which life stages are most appropriate? Which age/size class is appropriate? Which tissue should be chosen? Fish of which trophic level should be caught? In this contribution, influences of these factors on fish levels of PS (e.g., mercury, PFOS, HCB, HBCDD) will be evaluated. It will also be assessed whether the data allow deriving factors for the conversion of whole body to fillet monitoring data and vice versa. Another aspect is to test whether the normalization of biota monitoring data (e.g., lipid normalization, trophic level normalization) enhances comparability.

Ecotoxicology of micro and nanoparticles: Mechanistic

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approaches to understand their risk for the environment and human health

646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms
S. Pellegrin, Griffith University / BioSmart Research Centre / Griffith School of Environment; P.A. Neale, Griffith University / School of Environment; A. Kumar, CSIRO / Centre for Environmental Contaminants Research; L. Rintoul, Queensland University of Technology; F.D. Leusch, Griffith University / Australian Rivers Institute

Microplastic pollution has become a serious environmental concern. Microplastics associated with wastewater treatment plant (WTWP) effluent have been found globally in marine and freshwater environments. Nevertheless, the concentration of microplastics discharged via wastewater after different treatment processes remains less understood. In this study, we identified microplastics in the wastewater effluent from three major WWTPs utilizing primary, secondary and tertiary treatment processes in Sydney, Australia. A novel validated sampler was designed for in situ collection of microplastics from wastewater effluent. The sampling method was combined with an efficient sample processing procedure to enhance the accurate detection of microplastics. The results indicated that primary effluent contained an average 1.5 microplastics/L. The amount of microplastics reduced to 0.6 microplastics/L after secondary treatment and 0.2 microplastics/L after tertiary treatment. Polyester fibres and polyethylene beads were predominantly detected in wastewater effluent, which possibly originate from synthetic clothing and cosmetic products, respectively. This suggests that WTWPs can act as a significant pathway to release microplastics to the aquatic environment, given the large volume of treated wastewater being discharged on daily basis. The effects associated with wastewater-based microplastics (e.g. fibres and beads) were thus investigated by exposing two freshwater organisms, a water flea (Ceriodaphnia dubia) and a sediment-dwelling midge larvae (Chironomus tesserpi), to microplastics in water and sediment, respectively, at concentrations within the range of environmentally realistic concentrations. A dose-dependent effect was observed after acute and chronic exposure of C. dubia to microplastics, with fibres showing more significant effects, though chronic effects were only observed at concentrations six times higher than corresponding environmental levels. Further, exposure to an environmentally relevant concentration of microplastics adversely affected the survival, growth and emergence of C. tesserpi. Size-dependent effects were observed with microplastics, with beads in the size range of 10-27 μm showing more pronounced effects. Our study demonstrates that microplastics are released into the environment by WTWPs and can have effects on freshwater organisms at concentrations within an order of magnitude of environmentally relevant levels.

647 What is in our plastic? In vitro toxicity of extracts from plastic products
L. Zimmermann, Goethe University Frankfurt am Main; C. Völker, Institute for Social-Ecological Research; M. Wagner, Norwegian University of Science and Technology / Department of Biology

The ubiquitous abundance of plastic litter in aquatic ecosystems causes concern over their potential ecological and health impacts. So far, most toxicity studies focus on physical effects of plastic particles and chemical effects of sorbed environmental pollutants. The effects of chemicals intrinsically present in plastics, i.e. plasticizers or degradation products, at environmentally relevant concentrations have been less understood. Nevertheless, it is well established that these chemicals migrate from consumer products, thus representing a source of exposure to wildlife and humans. The aim of the current study is to investigate the in vitro toxicity of chemicals leaching from various plastic products and to characterize them using non-target chemical analysis. Different plastic types shall be ranked according to the toxicity of their leachates. Thirty-four plastic consumer products made of high-density polyethylene (HD/LDPE), polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polyactic acid (PLA) were cut and extracted in a sonication treatment. The extracts were tested for unspecific toxicity in the Microtox assay, for estrogenic and anti-androgenic activity in yeast-based reporter gene assays as well as for their potential to induce an oxidative stress response in the AReC32 assay. Two-thirds of the products leached chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response. Nine plastic products released chemicals that were antiandrogenic and four slightly estrogenic. Overall, PVC and PUR extracts induced the highest toxicity in terms of potency and number of affected endpoints as almost all extracts triggered a high specific toxicity, oxidative stress and anti-androgenic activity. In contrast, PET extracts were less toxic with only one sample inducing oxidative stress. Interestingly, all PLA extracts produced a very high unspecific toxicity. Effects of HDPE, LDPE, PP and PS extracts strongly depended on the product. Our findings indicate that extracts of plastic products induce a range of toxicological endpoints, including unspecific toxicity, oxidative stress and endocrine activity. So far, plastic products have been consistently tested and identified as a major toxicological response. This demonstrates that a substantial part of plastic products are a potential source of exposure to toxic chemicals.

648 Microplastic size-dependent toxicity, oxidative stress induction, and multixenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus koreanaus)
C. Jeong, J. Lee, Sangkyunkwan University

Plastic pollution, a great concern in these days due to their world-wide distribution, persistence, and increasing amount of small-sized plastic products due to degradation of larger plastic debris. However, little is known about their impacts on marine organisms, particularly at the molecular level. Here the dependence of microplastic toxicity to the monogonont rotifer (Brachionus koreanaus) on particle size was investigated by studying the ingestion and egestion of recently labeled 0.05, 0.5, and 6 μm polystyrene microbeads. Exposure to polystyrene microbeads led to significant size-dependent negative effects on growth rate, reproduction, and lifespan. In contrast, transmission electron microscope (TEM) analysis have revealed cellular damages in the rotifer B. koreanaus exposed to 0.05 μm microbeads, indicating nano-sized microbeads would cause more serious impacts on aquatic organisms. To further explore the defense mechanisms in response to different sizes of microbeads, the activities of several antioxidant-related enzymes and phosphorylation statuses of mitogen-activated protein kinases (MAPKs) were determined. Particularly, 0.05 μm microbeads have inhibited multixenobiotic resistance (MXR), resulting increase of sensitivity of rotifer to environmental pollutants. Our study provides a better understanding of molecular responses in the rotifer B. koreanaus in response to microplastics and their potential impacts on the aquatic ecosystem.

649 Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio)
B. Cormier, EPOC University of Bordeaux; M. Larsson, Orebro University / Marine Environment and Environmental Protection Area, Esbjerg; F. Dang, EPOC / Centre de Recherche (MTM); L.W. Yeung, University of Oporto / Department of Chemistry; C. Clérendeau, EPOC University of Bordeaux; A. Karrman, Orebro University / MTM Research centre; B. Morin, University of Bordeaux; EPOC; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Béguin, X. Cousin, IFREMER / Laboratoire de Recherches Halieutiques de La Rochelle; J. Cachot, University of Bordeaux / EPOC; S. Keiter, Orebro University / MTM Research centre

The growing production of plastics increased the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 μm. MPs can result from runoff and degradation (mainly photodegradation) or weathering of larger plastic debris. MPs are harmful to the environment, for instance, by potential sorption of (persistent) organic pollutants (POPs) and hydrophobic pollutants can be adsorbed, including persistent organic pollutants (POPs). In marine environments, such chemicals are found at high concentrations in the surface layer, where low-density microplastics are most abundant. Indeed, these small particles can act as vectors and carriers for a wide range of pollutants and be ingested directly by organisms, causing chronic physical and/or toxicological effects. While accumulation of MPs in aquatic ecosystems is a growing concern in society, the toxicity of MPs for wildlife and the processes of sorption of organic pollutants onto MPs are very complex and poorly understood. Therefore, objectives of the present study were to investigate the sorption kinetics of two model pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of POPs, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP absorbed by the MPs was constantly decreased. On the toxicity aspects, no acute toxic effects were observed, using FET test with microplastics particles (virgin or spiked). No differences were found regarding sub-lethal endpoints (genotoxicity, phagocytosis response (PR) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or commercial algae. Results showed that MPs can be vectors of pollutants which sorb at the surface over time. The toxicity of MPs as carriers of POPs cannot be demonstrated with 96h exposure to LDPE microparticles. Experiments are currently being done to test the toxicity of MPs.

650 Comparative role of microalgae and microplastics in the effects of chlorpyrifos on molecular biomarkers in marine mussels
L. vidal-d.de Vigo; B. Fernández, IEO; M. Albentosa, Instituto Español de Oceanografía / Marine Environment and Environmental Protection Area, Fisiología y Ecotoxicología of Bivalve Molluscs Department; J.A. Campillo, Instituto Español de Oceanografía / Centro Oceanográfico de Murcia; J. Bellas, IEO

Plastic particles within the microns range (microplastics, MP) are increasingly found globally in marine environments. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 μm. MPs can result from runoff and degradation (mainly photodegradation) or weathering of larger plastic debris. Microplastics are most abundant. Indeed, these small particles can act as vectors and carriers for a wide range of pollutants and be ingested directly by organisms, causing chronic physical and/or toxicological effects. While accumulation of MPs in aquatic ecosystems is a growing concern in society, the toxicity of MPs for wildlife and the processes of sorption of organic pollutants onto MPs are very complex and poorly understood. Therefore, objectives of the present study were to investigate the sorption kinetics of two model pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of POPs, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP absorbed by the MPs was constantly decreased. On the toxicity aspects, no acute toxic effects were observed, using FET test with microplastics particles (virgin or spiked). No differences were found regarding sub-lethal endpoints (genotoxicity, phagocytosis response (PR) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or commercial algae. Results showed that MPs can be vectors of pollutants which sorb at the surface over time. The toxicity of MPs as carriers of POPs cannot be demonstrated with 96h exposure to LDPE microparticles. Experiments are currently being done to test the toxicity of MPs.
habitats is that they might act as vectors of pollutants to marine organisms, since hydrophobic organic contaminants with low water solubility tend to concentrate on the surface of these particles. In this study we have compared the role of polyethylene MPs and microalgae (MA) of similar size, as vectors of the organophosphorus insecticide chlorpyrifos (CPF) to Mytilus galloprovincialis—marine mussels. With that aim, CPF pre-exposed MP and MA were offered to the mussels in a batch incubation bioassay under in vivo conditions and CPF in the mussels was measured. AChE activity in digestive gland and gills was significantly inhibited at all CPF treatments, disregarding exposure time. Levels of GST activity in the digestive gland in the three CPF treatments (CPF, MA+CPF and MP+CPF) after 7 days exposure were significantly higher than levels in treatments without CPF. However, after 21 days exposure, GST activity in the controls significantly increased, and differences with controls disappeared. For GST in gills, a significant increase in activity was observed in the MP, CPF and MA-CFP treatments after 7 days, compared to the MA control. When the nine biomarkers recorded are combined using the Integrated Biomarker Response (IBR) index a similar response in the three CPF treatments is initially observed (7 d), but after 21 d an enhanced response in observed in the MA+CPF and MP+CPF treatments only. In conclusion, AChE inhibition was similar in all CPF treatments disregarding the presence of particles. However, both MP and MA particles in CPF-exposed mussels produced in the long term an increase in biomarker response compared to waterborne exposure. Therefore MP seem to play a similar role than natural organic particles as vectors of organics to marine organisms.

651 Poster spotlight: TH001, TH002, TH003

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)

652 Dissipation of the carcinogenic ptaquiloside in water resources

L. Rasmussen, Metropolitan University College; J.S. Wu, P. Clausen-Kaas, University of Copenhagen; J. Andersen, D. Lindqvist, Metropolitan University College; B.W. Strobel, University of Copenhagen / Plant and Environmental Sciences; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences

Ptaquiloside (PTA) is a natural carcinogen found in a number of ferns Worldwide. The distribution and occurrence of PTA is best known from the Bracken ferns (genus Pteridium) which are classified in Group 2B Possibly carcinogenic to humans by WHO/IARC. The content of PTA in Bracken is highly variable (up to 5 w%-). PTA is readily leached from Bracken stands from where it can enter the soil, waterways or potentially contaminate groundwater. Several records of PTA contamination of surface water and upper groundwater exist from Denmark and Great Britain. The fate of PTA in surface and ground water has not been studied. Under sterile conditions, dissipation (= hydrolysis) of PTA in aqueous solution follows classical first order kinetics: \(k_{eq} = k_{acid}[H^+] + k_{neutral} + k_{alkali}[OH^-][H^+].\) The rate constants are: \(k_{acid} = 25.7±1.0 \text{ M}^{-1} \cdot \text{h}^{-1}\); \(k_{neutral} = 9.5±6.0 \text{ M}^{-1} \cdot \text{h}^{-1}\) and \(k_{alkali} = 4.8±0.0 \text{ M}^{-1} \cdot \text{h}^{-1}\). The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol\(^{-1}\). Hence, hydrolysis is a function of both pH and temperature. The purpose of this investigation was to study the degradation of PTA under natural conditions using 10 different surface and groundwater samples from Denmark and to compare the degradation kinetics with the existing model for hydrolysis. Degradation was fast in natural non-sterilised lake waters with half-lives from 5 to 25 h. All PTA were degraded within 200 h. Sterile controls had no degradation. Winter samples exhibited slower degradation (half-lives up to 100 h). Sterile samples followed the existing model for hydrolysis closely, i.e., no degradation at neutral pH. PTA persist considerably longer in groundwater. Half-lives in groundwater ranged from 7 to approx. 50 days with fastest degradation in alkaline waters. The existing model for hydrolysis could generally predict the rate of degradation in groundwater. However, the model did not perform well at low or high pH. Pterosin B was formed as the end product by hydrolysis in the tested groundwater with a molar ratio of approx. 1:1 for PTA:Pterosin B. However, under weak acid conditions, only approx. 10% of the potential pterosin B were formed. The risk of leaching from Bracken stands and contamination of surface waters is highest during the winter season. PTA has the potential of contaminating mainly shallow aquifers as the compound can persist for up to several months in contact with groundwater. The risk is expected to be highest at near-neutral conditions in aquifers.

653 On-line detection of algal toxins in sea water

S.F. Bodini, SYSTEA; F. Pasquazzi, Systea Spa; A. Porchetta, L. Micheli, G. Volpe, L. Fabiani, University of Tor Vergata; L. Sanfilippo, P. Moscetta, Systea Spa; G. Palleschi, University of Tor Vergata

Natural toxins produced by plants, algae and microorganisms represent a serious concern for public health. Current detection methods need expensive equipment, trained personnel and complicated protocols. In particular, the determined marine biotoxins, released as a consequence of toxic algae blooms, is performed offline on fish / shellfish homogenates rather than on-line, resulting not appropriate for monitoring programs that require real-time warnings like in specific situations relevant for public health, such as bathing sites and aquaculture plants. Thus, there is a special need for on-line, continuous, rapid and sensitive field tests. To fill this gap, a portable spectrophotometer was developed and incorporated in the instrument. Laboratory measurements were executed to validate the prototype efficiency to detect sub-pbq concentrations of the algal toxins. The obtained calibration lines were consistent with the strict requirements limiting the presence of the toxins in environmental waters. On-line suitability was demonstrated by a field installation on a floating platform in the port of La Spezia, Italy, for daily monitoring of real marine water samples, in which the instrument was integrated together with a database for real-time data analysis. The advantage of the environmental conditions on O. cf. ovata proliferation and toxin production had been poorly studied. Therefore, the need for increase knowledge on potential risks for humans and ecosystem stimulated research in the field. An Italian interdisciplinary network was created, including scientists from the Academia and operators of the regional environmental protection agencies and food safety laboratories. This joint effort led to clarify many of the aspects related to the O. cf. ovata phenomenon that still represents one of the major threats to humans in the Mediterranean area. This presentation is meant to summarize the results of our studies on O. cf. ovata, highlighting inter- and intra-specific variability, strains, variables, stress resistances detected toxins and, some characters, connecting differences to the risk that PLTX could pose to humans following inhalatory, dermal and oral exposure. Phylogenetic relationships among many isolates of Mediterranean O. cf. ovata were investigated as well as innovative molecular qPCR based assay was developed for monitoring activities. A general overview of the environmental conditions that favour O. cf. ovata proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing many of the palytoxin-related issues, may serve as template for facing in due time any emerging toxin-related threat to humans.
de Catalunya / Centre de Estudis del Rius Mediterrani; M. Abril, Universitat de Vic / Universitat Central de Catalunya / BETA Technological Centre; M. Ricart, Universitat de Vic / Universitat Central de Catalunya / BETA Technological; N. Sellares, Universitat de Vic Universitat Central de Catalunya / Centre d’estudis dels Rius Mediterranians; J. Colon, S. Ponsà, Universitat de Vic Universitat Central de Catalunya / BETA Technological Centre. The Mediterranean region is one of the most densely populated and industrially developed area in Spain. As a consequence, most of the rivers in this region are impacted by multiple anthropogenic stressors. One of these rivers is the Ter River (NE Spain), where human pressures are diverse and have increased in the last decades because farming, urban development and industry practices depends on its water. In addition, fluctuations in water discharge due to the Mediterranean climate create high variability of conditions along the Ter River. One of the major problems detected in Ter River in the recent years is the appearance of geosmin. This is a metabolite generated mainly by cyanobacteria and actinomycetes that, when die, is released into the water, giving it a bad smell and taste. Although some studies have described that the production of this metabolite depends on environmental conditions, the factors associated with its production are still not clear. This supports an economic activity of Sanitarians, from suppliers companies, since they cannot predict its appearance and have to act when customers complain. The aim of this study is to evaluate the co-relation between physicochemical parameters and geosmin appearance along the Ter River during one year, and to study seasonal variability of geosmin concentration. The study has been performed in four sampling sites across the upper-middle part of the Ter basin. The sampling frequency varied throughout the year. During the potential geosmin formation period (February to June), sampling was performed weekly while from June to December, sampling was performed monthly. The parameters analysed have been nutrient concentration, suspended solids, organic material, turbidity and geosmin concentration in water. Biofilm samples were taken in order to analyse the chlorophyll a content. The results obtained clearly reflected the seasonal variation in geosmin concentrations being its concentration higher in winter (32 ng/L). They also evidenced the N/P ratio as one of the key factors involved in the geosmin formation. However, a more in-depth analysis of the N/P ratio in water is still necessary in order to explain the mechanisms that generate the geosmin formation within the organism. For this reason, a mesocosms experiment that tests the influence of the N/P ratio on the geosmin formation within the biofilm could be the next step to follow.

656 Italian guidelines to assess and manage the risk associated to cyanobacteria blooms in water during bathing and recreational activities

M. Militandelli, Istituto Superiore di Sanità / Dip. Di Ambiente e Salute; E. Fanari, F. Buratti, Istituto Superiore di Sanità / Dept. of Environment and Health; E. Testai, Istituto Superiore di Sanità / Dip. Di Ambiente e Salute. Many species of cyanobacteria thrive in different aquatic environments, where they can produce cyanotoxins with different toxicological profile. The still growing anthropic pressure and climate changes are causing the expansion in terms of time and space of their blooms, increasing the concerns for human health in several exposure scenarios. The Italian guidelines for the management of cyanobacterial blooms in bathing water, firstly drew up for the implementation of European bathing water directive (Directive 2006/7/EC), have been recently updated. A risk-based approach has been developed after a thorough revision of the current scientific knowledge on cyanobacteria distribution in the Italian Lakes and on chlorophyll a as an indicator for blooms of different cyanobacteria. The possible exposure scenarios have been considered: oral, dermal and inhalation exposure to cyanotoxins, during recreational activities, have been individually examined, to develop a framework of thresholds and actions aimed at preventing harmful effects for bathers. Three phases of attention relative to monitoring plans have been consequently defined: routine, alert and emergency, suggesting the actions to take at any moment. Parallel to environmental monitoring, a multi-step health-surveillance system has been proposed, aimed at collecting important epidemiological information and at limiting unnecessary accesses to the hospital through a screening action by local workers (lifeguards, local health units, pharmacies, etc.). All the technical/practical information on strategies, methods and thresholds used to define the Italian guidelines have been compared among different matrices, to the analysis and the reporting to health authorities are provided. In summary, guidelines, also b

657 Identification and prioritization of emerging risks for food safety: climate change as a driver

A. Magriore, European Food Safety Authority (EFSA) / Risk Assessment and Scientific Assistance Department; A. Ronfani, EFSA European Food Safety Authority / Risk Assessment and Scientific Assistance Department; A. Ertas, EFSA European Food Safety Authority; G. De Santis, G. V. Verloo, G. Caridi, G. D. Dhollander, Y. Van der Stede, F. Boelaert, M. Binaigla, J. Tarazona, EFSA European Food Safety Authority. According to the General Food Law, the European Food Safety Authority (EFSA) is required to identify emerging risks in the fields within its mission. EFSA has developed a methodological framework for identification of emerging risk, starting from a preliminary identification of priority emerging issues through knowledge networking activities. The long term anticipation of emerging risks includes the identification of drivers. Drivers are the underlying natural or human-induced factors that directly or indirectly cause emerging risks. Climate change is recognised as a critical driver and its impact on the occurrence and toxicity producing phycotoxin, bacteria and pathogenic viruses and on other food safety domains was demonstrated. With the aim of further exploring tools to identify and prioritise emerging risks, EFSA initiated a project focusing on climate change as a driver of emerging risks for food and feed safety, including plant and animal health. A knowledge discussion group involving the major institutions involved with climate change has been created. The group will define criteria to identify relevant subdrivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.

Advances in evaluating and regulating endocrine disruptors

658 Hazard identification of endocrine disrupting properties of pesticides on non-target organisms: state of the art and future perspectives

A. Membesi-EfSA, EPPO - European Food Safety Authority / Pesticides Unit; M. Arena, EPFA - European Food Safety Authority / Pesticides; D. Auteri, EPFA - European Food Safety Authority / Pesticides Unit. According to the Regulation (EU) no 283/2013, setting out the data requirements for active substances, in accordance with Regulation (EC) No 1107/2009 concerning the placing of plant protection products on the market, the endocrine disrupting properties of pesticides should always be assessed, as substance identified as an endocrine disruptor should not be approved. Most of the current knowledge about endocrine disruption is related to EATS (Estrogen, Androgen, Thyroid and Steroidogenesis) modalities in vertebrate organisms i.e. there is a good mechanistic understanding on how those modalities can lead to an adverse effects. The OECD conceptual framework and the OECD 150 provide an overview of the existing assays for the endocrine disruptors (ED) hazard identification and guidance on how to interpret the results of those tests. A suitable testing strategy which allows the identification of ED properties of pesticides through EATS modalities is available for some taxa of non-target organisms (i.e fish and amphibians). The analysis confirmed that the available test methods and knowledge on birds’ endocrinology do not allow a full ED assessment although they can provide supportive information. In the case of reptiles, appropriate standard test methods are completely missing. In some circumstances, extrapolation between taxa could be scientifically supported. However, consideration should be given to taxon-specific differences. Extrapolation between mammals and amphibians regarding the ED hazard identification through the thyroidal modality has been investigated in the past. A similar analyses has not been done for EAS modalities, however, in some cases extrapolations among oviparous vertebrates is scientifically justified e.g. in the case of the steroidogenesis pathway leading to reproductive dysfunction (more specific for EATs). The main scope of this work is to present a critical overview of the available standardised test methodology for the ED assessment of non-target organisms, including consideration on the extrapolation between taxa. In addition, possible future perspective and research needs are discussed.

659 Contaminants of emerging concern in the North American Great Lakes: Evidence of reproductive disruption from field and laboratory studies

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; L. Thomas, St. Cloud State University / Biological Sciences; L. Wang, St. Cloud State University / Chemistry; C. Pipolatti, St. Cloud State University / Aquatic Toxicity Laboratory; J. Z. Jorgenson, St. Cloud State University / Environmental Contaminants; S. Elliott, U.S. Geological Survey / Minnesota Water Science Center; M.E. Brigham, U.S. Geological Survey. Analysis of nearly 500 surface water samples collected as part of the Great Lakes Restoration Initiative at 54 sites in tributaries of the North American Great Lakes Watershed confirmed the ubiquitous presence of Contaminants of Emerging Concerns (CECs) in anthropogenically impacted aquatic environments. Cluster analyses of commonly detected CECs in this data matrix suggests that the co-occurrence of approximately half of the CECs can be attributed to dichotomous urban or agricultural upstream land use. Mixtures found in watersheds with urban influences commonly contained steroidal estrogens, BPA, alkylphenols, pharmaceuticals and personal care products. Agriculturally influenced sampling sites contained herbicides and pesticides in addition to BPA and alkylphenols, but mostly lacked pharmaceuticals and personal care products. Almost 3,000 resident and caged sunfish (Lepomis spp.) were collected from 27 of the 54 sampling sites and analyzed for indicators of stress associated with CEC exposure. In the presence of high aqueous CEC concentrations, glucose concentrations spiked in sunfish...
biochemical and molecular analyses revealed that concurrent with indicators of toxic stress, biomarkers of reproductive potential declined. To further examine the population level consequences, fathead minnows (Pimephales promelas) were exposed in the laboratory for three generations to the empirically derived urban CEC mixture at three environmentally relevant concentrations. Mixtures at environmentally management controlled concentrations enhanced fecundity in the F2 and 3 generations, while higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicates that CECs in Great Lakes tributaries may impact fish population health and sustainability.

660 AOP-informed assessment of Endocrine Disruption in freshwater crustaceans

K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment; M. Cronin, Liverpool John Moores University; E. Evensen, Norwegian School of Veterinary Science; L. Enevseth, The Arctic University of Norway; F. Falciani, University of Liverpool; T. Iuchi, YOKohama City University / Molecular Environmental Endocrinology; C. LaLone, U.S. EPA / Mid Continent Ecology Division; Y. Li, NIVA Norwegian Institute for Water Research / Marine Ecology; O. Cornet, Université Pierre et Marie Curie / School of Pharmacy and Biomolecular Sciences; E. Perkins, US Army Corps of Engineers ERDC; T. Rundberget, Norwegian Institute for Water Research; B. Salbu, Norwegian University of Life Sciences; I. Sylte, The Arctic University of Norway / Department of Medical Biology; D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Polymer Research and Dehydration Research; N. IATA, 5) identify potential EDCs and 6) practical imp

Emerging contaminants often appear as mixtures of differing concentrations across a landscape. Traditional toxicological assays as well as receptor binding as say that hepatotoxicity may interfere with typical endocrine and hepatotoxicity-related pathways. The present study is driven by the hypothesis that hepatotoxicity may interfere with VDG synthesis in the liver / eosinophil fish. Thus, we investigated the effects of two well-known hepatotoxicants, acetaminophen (APAP) and isoniazid (INZ), on zebrafish (Danio rerio) in a 21-day flow-through exposure test according to OECD guideline 230. Various hepatotoxicity- and endocrine system-related endpoints were recorded: - mRNA expression of different endocrine-related (vgl, vr3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoal, cyp2k19 and cyp2j1) in the liver; - hyaluronic acid (a biomarker for liver toxicity) levels in head/tail homogenates; - liver histology and ultrastructure; Both APAP and INZ had different effects on exposed fish. While APAP did not cause any histopathological alterations in the liver, INZ significantly induced hepatocyte degeneration. VDG levels in APAP-exposed females were elevated, while no effect was observed in INZ-exposed fish. Likewise, vitellogenin levels in the liver differed between both compounds and indicate that both did interact with different endocrine- and hepatotoxicity-related pathways. The results from both studies will further be evaluated with respect to their potential for the development of an adverse outcome pathway (AOP) for interference of hepatotoxicity with the VDG response in fish.

663 Single Pulse Exposure of Different Life Stages of Zebrafish to the Selective Estrogen Receptor Modulator Tamoxifen Citrate

S. Kroesen, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; C. Schaefers, Fraunhofer-Institut / Ecotoxicology; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; E. Ellebrecht, M. Teigeler, Fraunhofer IME / Ecotoxicology

The discussion about the regulation of endocrine disruptors (EDs) is on-going between groups of scientists, authorities and stakeholders. Especially dose-dependency, low dose effects and effect thresholds are still under debate. To address parts of these questions, a static life-cycle test with zebrafish (D. rerio) has been performed to examine if a pulse exposure of an ED might generate: - distinguishing effects and the establishment of a dose-response relationship is possible. The results will be used for a comparison with available data originating from a flow-through study with TC in zebrafish. A water-sediment system has been set up to expose different life-stages (group A: 40 eggs, group B: 20 juveniles, group C: 16 adults) to a known ED, Tamoxifen citrate (TC). Observed endpoints included early-life stage endpoints, growth parameters, and adult growth, sex ratio, vitellogenin levels and F2-generation early-life stage. Four concentrations of TC were applied as a pulse in three replicates each, ranging from 125 µg/L to 1000 µg/L (spacing factor 2). Four controls replicates were included. Mortalities occurred in all developmental stages (groups A to C), especially in high concentrations (500 µg/L, 1000 µg/L). In sexually mature fish (group C) mortality was higher in males. A decline in fertility could be observed for group C, possibly related to the higher male mortality. Total egg numbers appeared unaffected. The results were mirrored for fish introduced as juveniles (group B): While fertility rates were not influenced negatively, fecundity was lower in remaining concentrations (125 µg/L, 250 µg/L). Changes in egg morphology were noticed shortly after exposure (group C). Consequently, F1-fish originating from group C showed a dose-dependent decrease in survival rates and growth. Although reproduction data are difficult to be attributed to endocrine activity, an influence on the endocrine system of the test animals seems apparent. Particularly sex specific effects in F0-animals as well as an impaired early life-stage in F1-animals are of highest interest. Further data on vitellogenin and reproduction will help clarifying pending questions. Additionally, several other accessible datasets from zebrafish studies featuring paired pulsed and flow-through exposures of EDs with diverse dissipation times will be integrated in the concluding assessment. The final objective is to deduce possible effect thresholds based on internal concentrations.

BIER is good for you: How biotransformation and elimination rate information can improve chemical assessments
A Tiered Approach for Screening Chemicals for Biomagnification Potential in Freshwater Oligochaete and Estuarine Polychaete

S. Sangion, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; P. Gramatica, E.U. University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)

Bioaccumulation is a process in which the chemical concentration in an organism exceeds the concentration in the respiratory medium, the diet or both and is an integral aspect of hazard and risk assessment. Strong correlations between partitioning properties such as the octanol-water partition coefficient (Kow) and the octanol-air partition coefficient (Koa) and the water-respiring and air-breathing organisms have led to Kow and Koa being the primary screening criteria for bioaccumulation assessment. However, primary biotransformation rate constants (kφ) and half-lives (HLφ) are also critical determinants of bioaccumulation. Here we present a tiered approach for screening the bioaccumulation potential of organic chemicals in air-breathing organisms. The tiered approach progresses from screening-level conservative assumptions based on Kow and Koa only to more realistic assumptions for, internal distribution, chemical properties and biotransformation (Tiers from 1 to 4 respectively). Biomagnification Factor (BMF) derived from a typical human diet as calculated by the Risk Assessment Identification And Ranking (RAIDAR) model is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13W. Nichols, U.S. EPA / ORD NHEERL Mid Continent Ecology Division; B. Wetmore, U.S. EPA / National Exposure Research Laboratory; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Critical Evaluation of a Human In Vitro Biotransformation Rate Database: Case Study of Seven Chemicals

K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMOD); A. Lookey, ARC Arnot Research and Consulting Inc.; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; M. Embry, ILSI, 13W. Nichols, U.S. EPA / ORD NHEERL Mid Continent Ecology Division; B. Wetmore, U.S. EPA / National Exposure Research Laboratory; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Despite the fundamental value of bioaccumulation rate information, relatively few measured in vivo data are available for humans compared to the thousands of chemicals requiring evaluation. Reliable models, laboratory measured in vitro bioaccumulation rate data and, in vitro-in vivo extrapolation (IVIVE) methods can be applied to address in vivo bioaccumulation rate data gaps and, coupled with data confidence assessment methods, uncertainty and data utility. We have developed a new database of >11,000 human in vitro bioaccumulation rate estimates (half-lives, clearance rates and rate constants) derived from liver microsomal, S9 homogenate, and hepatocyte-based assays for >8,500 organic chemicals from the literature and publicly available databases (i.e., ChEMBL). The database is comprised primarily of pharmaceuticals and pharmaceutical candidates from various experimental sources. The organic chemicals in the database represent a broad range of physical-chemical properties (Log Kow=4–13, Log Koa=0.01 to 47, kφ=0–400/h, kφ-in vitro =0–400/h, HLφ=0.001–480/d, C50%=1 μg/mL–1 mg/L) span about 8 orders of magnitude. We developed and applied novel data quality assessment methods based on proposed standardized testing guidance to address variability and uncertainty in the database. The data quality assessment methods included compiling physical-chemical property data (e.g., Kow, pKb, water solubility) for all of the chemicals and applying a mass balance in vitro model. The measured data quality scores (e.g., high or low confidence) may help identify datasets that are most appropriate for QSAR development and for other potential applications (e.g., bioaccumulation screening, prioritization). The score results are further examined in a case study of seven chemicals and the utility of high and low confidence biotransformation rate data, its merits and limitations for various use contexts, are discussed and overall key findings of the critical review of existing human in vitro bioaccumulation rate data are summarized.

666 Sediment-associated cyclic volatile methylsiloxanes: Biotransformation in a freshwater oligochaete and an estuarine polychaete

H. Selck, Roskilde University / Dept Science and Environment; R. Windfeld, Roskilde University / ENSPAC

Chemical regulatory legislation of organic contaminants is generally based on an assessment of the chemical potential to persist (P) in the environment, bioaccumulate (B) in biota, and possess potential toxicity. Applying standardized exposure setups (i.e., water-only exposure) as historically has been employed in environmental risk assessment may not reflect the hydrophobic organic contaminants (HOCs) in sediment-dwelling organisms because: 1) HOCs often accumulate in sediments to concentrations greatly exceeding the concentration in the overlying water; and 2) a number of papers illustrate that sediment-associated HOCs are available for uptake in benthic organisms. Alternatively, benthic invertebrates may be able to metabolize organic contaminants (i.e., biotransformation), thus reducing their body burden. However, available information on the biotransformation capacity of benthic organisms is very limited. We conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella tetraedra and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behaviour may add compound uncertainty to predictions of bioaccumulation and trophic transfer.
assessment of single chemicals. (iii) Development of PBTK models for environmental risk assessment of multiple chemicals. Generic PBTK models for single compounds in rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), stickleback (*Gasterosteus aculeatus*) and zebrafish (*Danio rerio*) have been developed. Physiological description and parameters proposed by Nichols et al. [1] were updated by an extensive literature search. New mathematical functions were proposed to integrate the main factors influencing the toxicokinetics (water temperature, growth dilution, reproduction cycle, …). Default values for compound-specific parameters were estimated by QSAR models based on hydrophobicity [2, 3]. An optional interaction terms was added to the mixture PBTK models for metabolic interactions such as competitive inhibition. Two case studies were selected based on availability of toxicokinetic (TK) and toxicodynamic (TD) data for single compounds and for mixtures. In the first case study, the interaction between melamine and cyanuric acid was studied and in a second case study, the interaction between chlorpyrifos and permethrin was modelled. The models developed enable to model interactions that are observed between exposure concentrations and final effects. The QSAR estimations of certain compound-specific parameters can compensate for the lack of data in fish. Extrapolation from one species to another with the various models developed can also help bridge gaps. [1] Nichols et al. 1990. Toxicol Appl Pharmacol 106:433-447. [2] Bertelsen et al. 1998.. Environ Toxicol Chem 17:1447-1455. [3] Nichols et al. 2006. Aquat Toxicol 78:74-90.

669 Application of Aqueous and Dietary In-Vivo Bioaccumulation Tests to Determine Biotransformation Rates, Elimination Rates and other Bioaccumulation Metrics

F. Gobas, Simon Fraser University / Resource & Environmental Management; M. Dimauro, K. Compton, Simon Fraser University; Y. Lee, Simon Fraser University / Resource and Environmental Management; V. Otton, Simon Fraser University / Resource and Env Management; J.C. Lo, Simon Fraser University / Biological Sciences; G. Allard, Simon Fraser University / Faculty of Environment

Bioaccumulation assessment is quickly evolving to respond to the need to conduct bioaccumulation assessment faster, better, cheaper while reducing animal use. In this presentation, we present novel methods for conducting both aqueous and dietary bioaccumulation tests that provide more information on bioaccumulation than currently used methods while also reducing animal use, effort and costs. Stream-lined aqueous bioconcentration test designs and dietary bioaccumulation studies following OECD 305 test guidelines are shown and discussed. A key element of the novel methods is the use of reference chemicals. In addition to experimental methods, we also present computational methods for deriving biotransformation rate constants, elimination rate constants and other bioaccumulation metrics with their associated error from the results of bioaccumulation tests. This involves an Excel worksheet, referred to as ADME calculator, that is specifically developed to interpret the results from aqueous and dietary bioaccumulation tests in terms of Absorption, Distribution, Metabolism and Excretion (ADME) rates including somatic and intestinal biotransformation rate constants, elimination rate constants, BCF and other bioaccumulation metrics. We further demonstrate that the application of reference chemicals can help to develop a full mass balance of the internal distribution of test chemicals in fish in the test and in the field under environment-specific exposure conditions. The application of the test results for determining exposure pathways of the test chemical under field conditions is illustrated. We conclude that bioaccumulation tests can become more effective in developing bioaccumulation profiles of chemicals when including reference chemicals.
Advances in environmental risk assessment of oil spills and offshore oil & gas operations (P)

MO001
An in-situ amphibian assay to evaluate oil spill-related toxicity in receiving freshwater systems
R. Krohn, University of Calgary / Dept. of Ecosystem & Public Health, Faculty of Veterinary Medicine; J. Muscatello, Lorax Environmental Services Ltd; J. Smits, University of Calgary / Ecosystem & Public Health Faculty of Veterinary Medicine

MO002
APPLICATION OF RISK BASED, TIERED ASSESSMENT OF PRODUCED WATER DISCHARGE IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT
M.G. Smjt, Shell International; O. Anako, SPDC Nigeria Ltd

MO003
Assessment of the biological impact of using chemical dispersants to remEDIATE oil spills in different environmental conditions using zebrafish embryos

MO004
Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea
R. Soto, Finnish Environment Institute, SYKE / Oil Research Centre; A. Ahvo, Finnish Environment Institute / Marine Research Centre; H. Kankaanpää, A. Reunamo, K.K. Lehtonen, K.S. Jørgensen, Finnish Environment Institute / Marine Research Centre

MO005
Biliary PAHs and enzymatic biomarkers in the teleost Eugeisson brasiliensis along four tropical estuaries in the Brazilian Northeast
J.S. Silva, R.N. Alves, UFPE Universidade Federal de Pernambuco / Zoology;
Human originated contaminants can appear diluted in estuarine and marine waters or accumulate in sediments. Chemical analysis provides key data on toxicant levels but gives limited inputs on their potential biological effects. The combination of biological responses with chemical data is essential to improve the assessment of environmental pollution. In this context, the use of benthic species for the assessment of biological effects of marine pollution is crucial for marine environment monitoring. In the Bay of Biscay, the common flatfish Solea solea, is considered to be recognized as sentinel species in pollution monitoring programmes. The present study uses juvenile Solea sp. (23.24± 1.22 cm standard length) exposed to contamination conditions to better understand toxicity processes involved based on biochemical biomarkers and histopathology. Solea senegalensis was exposed to three different experimental sets up: (a) contaminated sediments; waterborne metal (Cd) and (c) waterborne organic pollutant (Benz(o)pyrene). A battery of biochemical biomarkers was analysed in samples of liver and brain: Catalase, glutathione S-transferase, acetylcholinesterase and superoxide dismutase. Exposure to contaminated sediments led to reduction of catalase, glutathione S-transferase and superoxide dismutase activities and induction of acetylcholinesterase activities.

Exposure to waterborne toxicants provoked a reduction of catalase and glutathione S-transferase activities. Biochemical biomarkers in sole were sensitive enough to differentiate degree of response after three days of exposure. Histopathological responses were detected after long-term exposures showing higher prevalence of liver alterations such as hyperaemia, macrophagocyte changes and necrosis. The present laboratory experiments helped characterizing the impact of pollution in sole at different levels of biological organization and different time scales. Work funded by Spain (BFU2010-21466-C03-01, BFU2010-21466-C03-02), and by the Regional Government through Consorci Comarcal del Delta de l’Ebre (CAI-019). University of the Basque Country

MO008

BIOMARKER AND GENE TRANSCRIPTION VARIABILITY IN PERCH IN REFERENCE SITES USED FOR BIOMONITORING STUDIES

L. Forin, N. Asker, University of Gothenburg / Department of Biological and Environmental Sciences; M. Topel, University of Gothenburg / Department of Marine Sciences; T. Osterlund, Chalmers University of Technology / Mathematical Sciences; I. Parkkonen, J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences

Perch (Perca fluviatilis) has been used in biological effect monitoring point of sources in Sweden for many years, for example in studies of effects of industrial effluents. Since 1988, perch has also annually been included in a program for integrated coastal fish monitoring in three reference sites along the Swedish east coast, sites characterized by no or minor local anthropogenic influences. Long term studies of reference sites have provided the opportunity to follow the natural variability of physiological and biochemical endpoints (i.e. biomarkers) that define the changes of relevance in polluted sites. Using a set of physiological and biochemical endpoints (i.e. biomarkers) clear time trends for “early warning” signs of impaired health are noted in the perch from these three reference sites possibly as a result of increased baseline pollution. The data sets also show relatively large variations between years. To further investigate these time trends and to identify (i.e. biomarkers) additional temporal variation in biological parameters, global gene transcription studies using RNA sequencing was performed. Perch collected in 2010 and 2014 were selected as they showed variation in several biomarkers such as the activity of the detoxification enzyme CYP1A (EROD), plasma levels of vitellogenin, markers for oxidative stress, white blood cells count and gonad sizes. The RNA sequencing data were corrected for different reference sites only using EROD, GST and CAT when compared to AR-FRES. Higher PAH bioconcentration and enzymatic induction in E. brasiliensis fish from BJES and BPEC indicate that these fish are spending energy to biotransform and excrete these contaminants, which may have consequences to their growth and survival in such regions. The results indicate that BJES and BPEC receive a greater input of PAHs, associated with the higher population density and coastal activities at these regions. These potential sources will be used to monitor these PAHs in the future.

MO006

Bioaccumulation of Sulfur and Nitrogen Containing Hydrocarbons in Petroleum Substances

T. Parkerton, ExxonMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; A. Bleich, ExxonMobil Biomedical Sciences Inc; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; C. M. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; A. D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; M. Lampi, ExxonMobil Biomedical Sciences.

A recent study aimed to characterize the composition of petroleum substances from different categories indicated that a variety of sulfur and nitrogen heterocyclic compounds and specific lipid transferases were detected in the range of 0.00004% to 0.2% of the total extractable carbon and nitrogen, respectively. Given the limited information available on the bioaccumulation potential of these substances classes, a dietary bioaccumulation study with rainbow trout was performed. Representative compounds with log Kow values > 4.2 from five classes (sulfides, thiols, thiophenes, carbazoles and acridines) were investigated along with a positive control (hexachlorobenzene). Test compounds were added to the diet as a 1% mixture for a period of 28 days and analyzed at the end of the experiment. The results indicate that these fish are energy to biotransform and excrete these contaminants, which may have consequences to their growth and survival in such regions. The results indicate that BJES and BPEC receive a greater input of PAHs, associated with the higher population density and coastal activities at these regions. These potential sources will be used to monitor these PAHs in the future.

MO007

Biochemical biomarkers and histopathology in juvenile Solea senegalensis for early warning assessment of marine ecosystem health

T. Briaudeau, University of the Basque country UPV/EHU; A. Alves Dos Santos, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; G. Guerrero Limón, University of the Basque country UPV/EHU; I. Marigomez, Euskal Herriko Unibertsitatea / Zoology & Animal Cell Biology. Forthcoming, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; P. S. Carvalho, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIE.

MO009

Cellular and tissue-level biomarkers in mussels (Mytilus edulis) sampled in two different study areas in the Northern Atlantic

D. Fernández ESTACIA, UPV/EHU / Departamento de Zoología y Biología Animal; M. Igirigire, University of the Basque Country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Leuké, PIES University of the Basque Country; I. Marigomez, Euskal Herriko Unibertsitatea / Zoology & Animal Cell Biology. Forthcoming, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; M. Soto, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIE; B. Zaldibar, University of the Basque Country UPV/EHU / Department of Zoology and Animal Cell Biology, Centre of Experimental Marine Biology & Biotechnology; M. Soto, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIE;
Marine Biology and Biotechnology PIEUPVEHU

Biomarker approach has been widely used in mussel monitoring programs for several years. However, up to know it has not been commonly used in high latitude study areas. In order to establish reference values of cellular- and tissue- level biomarkers in the Northern Atlantic Ocean, mussels of two sizes (small, 2-3 cm; large, 3.5-4.5 cm) from selected polluted (commercial harbor & ports, WWTP dumping area) and reference sites in Tromsø (69° 40' N) and Trondheim (63° 26' N) were sampled in autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvBAS) in digestive gland epithelium, structural changes of digestive algaevi (MLR/MET), relative proportion of digestive and connective tissue (CTD) and histopathological alterations in the digestive gland were measured. In addition, lipofuscin and neutral lipid accumulation in the digestive gland were determined. Biomarkers responsive to chronic exposure (parasitic burdens and atresia, higher weighed prevalence values than in the reference site were recorded in the two polluted sites from Trondheim. Differences between the two mussel sizes were recorded in parasitic burden, large mussels exhibiting a higher level of parastization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the polluted sites than in reference sites in both study areas. Lysosomal and liposomal analysis were a dominant element for both, two of the oil spills. Biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679266), Basque Government (IT810-13) and UPV/EHU (UIF 11/37).

MO010

Cytotoxicity of the WAF of naphthenic North Sea crude oil with and without dispersant in hemocytes of the marine mussel Mytilus galloprovincialis (L.) G. Nicolussi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU). Basque Country, Spain; A. Katsumi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; D. Bilbao, University of the Basque country (UPV/EHU) / IBrea Research Group, Department of Chemistry, University of the Basque Country. UPV/EHU / Plentzia Marine Station (PE-UPV/EHU) & Dep Analytical Chemistry, M.P. Cajaraville, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE.

Oil pollution coming from accidental oil spills and from activities related to oil production and processing presented a risk to hemocytes to expose every toxic oil spill. Oil biomarkers may vary depending on environmental parameters such as temperature. There is a need to develop efficient tools to assess the risks of oil pollution and of oil spill response strategies, as the use of dispersants. The aim of this work was to apply an in vitro approach using hemocytes of the marine mussel Mytilus galloprovincialis as a model to evaluate the toxicity of the water accommodated fraction (WAF) of naphthenic North Sea crude oil produced at different temperatures (10, 15 and 20°C) with and without the dispersant Finasol OR 52. In order to evaluate the contribution of the dispersant on the toxicity of the WAF plus dispersant, the cytotoxicity of the dispersant alone was also tested. Primary cultures of hemocytes were exposed in glass covered microplates to different dilutions of WAF (0.25, 0.5, 2.5, 5, 25, 50 and 100%) with and without the dispersant and to the dispersant alone at the same concentrations present in the WAF dilutions of oil plus dispersant (1, 2.5, 12.5, 125, 250 and 500 mg/L). After 24 h exposure, cytotoxicity (MTT test) and ROS production were measured. WAF was moderately cytotoxic to mussel hemocytes. WAF produced at different temperatures showed similar cytotoxicity to hemocytes. A slight but significant decrease in cell viability occurred at 25, 25 and 100% WAF (proportions of 10, 40% and 25% at 10°C, 50 and 20°C). These results suggest that relevance of temperature of WAF production on its cytotoxicity is limited. WAF caused a significant induction of ROS production in hemocytes, indicating occurrence of oxidative stress. When tested alone, the dispersant caused a slight but significant decrease in cell viability at the two highest concentrations. However, WAF produced with dispersant at the three different temperatures was not toxic to hemocytes. These results appear to indicate that the dispersant efficiently reduced the toxicity of the crude oil WAF in the selected cell model. Overall, the in vitro toxicity testing approach in mussel hemocytes could be used as a rapid screening tool for environmental risk assessment of oil spills and oil response strategies in the marine environment. *Funded by EU H2020 GRACE project (679266), Spanish MINECO NACE project (CTM2016-81130-R), Basque Government (consolidated research group IT810-13) and UPV/EHU (UIF 11/37).

MO011


Inorganic cation and amine determinations are important to assess salt build-up in the marine neutralizing solutions, or to meet regulatory discharge compliance from petroleum and municipal treatment plants wastewater. Additionally, municipal water plants require cation determinations to monitor secondary water characteristics. In the petroleum industry, alkanolamines (monoethanolamine, diethanolamine, and methyl diethanolamine) are used routinely to prevent corrosion during transportation to the refinery or to remove sour gases during the refining process. Pressing plants require cation neutralization to maintain structural burdens and alatresia, higher weighed prevalence values than in the reference site were recorded in the two polluted sites from Trondheim. Differences between the two mussel sizes were recorded in parasitic burden, large mussels exhibiting a higher level of parastization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the polluted sites than in reference sites in both study areas. Lysosomal and liposomal analysis were a dominant element for both, two of the oil spills. Biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679266), Basque Government (IT810-13) and UPV/EHU (UIF 11/37).
MO014 Effects of a coastal oil spill on marine invertebrates and their potential to recover
F.M. Lemos, S. Silva, Instituto Politécnico de Leiria / MARE ILEiria
There has been an increasing public concern and focus on marine contamination issues mainly due to the arising of emergent pollutants, posing a major threat to human and environment health. Still, the contamination by polycyclic aromatic hydrocarbons (PAHs) remains one of the most ubiquitous sources of pollution in the marine environment, being reported to elicit toxic, carcinogenic and mutagenic effects on marine biota. Moreover, the assessment of these impacts in costal invertebrates after a spill, the extent of these effects and energetic trade-offs, potential recovery, and even which species to use is still deemed for an effective environmental contamination assessment. After an accidental industrial oil spill at the rocky shore of Peniche, Portugal in the summer of 2018, the water was analyzed during the low-tide for PAHs one week later and regularly throughout six months in the spilled beach and in 7 other rocky beaches in the vicinity. Also, at all locations, Patella depressa and Gibbula umbilicalis organisms were collected, and several biochemical biomarkers were evaluated. The results show the absence of the effects of PAHs in the organism’s ability to recover over time was also addressed and these tools and species potential for coastal monitoring pollution scenarios discussed.

MO015 Effects of oil exposure on visual function in early life stage fishes
T.J. Magnusson, University of North Texas / Biology; A.J. Khursigara, The University of Texas at Austin / Marine Science Institute; E. Allmon, The University of Texas at Austin; A. Ebaugh, University of Texas Marine Science Institute / Department of Marine Science; R.M. Heuer, University of Miami / Marine Biology and Ecology; J.D. Stieglitz, M. Grossel, RSMAS University of Miami / Marine Biology and Ecology; A.P. Roberts, University of North Texas / Advanced Environmental Research Institute
The Deepwater Horizon oil spill released millions of barrels of oil into the Gulf of Mexico, coinciding with peak spawning periods of ecologically important fish species, such as mahi-mahi (Coryphaena hippurus), drum (Sciaenops ocellatus), and sheepshead minnow (Cyprinodon variegatus). Downregulation of genes important in eye development and function, as well as morphological abnormalities have resulted from polycyclic aromatic hydrocarbons (PAHs) present in the oil at concentrations less than 10 µg/L, impacting fish vision. The concentrations of larval oil were determined with the range from 6.92 µg/L to 53.89 µg/L, by analyzing water samples collected along coastal areas in Hong Kong. Standard acute toxicity tests were conducted to investigate their toxic effects to the marine microalgae Isochrysis galbana and Chaetoceros gracilis (primary producers), the intertidal copepod Tigriopus japonicas (a primary consumer), the brine shrimp Artemia franciscana and fish embryos of the marine medaka Oryzias melastigma. Our results showed that although all test marine species were not very sensitive to larval oil with the ranking of their acute median lethal concentrations (LC50) that were all above the estimated hazardous concentration for 5% of species (HC5), the results of a probabilistic risk assessment showed that the local marine ecosystem had 65.7% of chance to be at risk (i.e., the neurotoxicity > 1) from exposure to larval oil using Monte Carlo simulation, indicating that the current risk was unacceptable high. Hence, monitoring and control on the use of larval oil as mosquito control pesticide would be urgently needed to mitigate its ecological risks.

MO016 Effects of oil spill on coastal seaweed in the Arctic
S. Wegeberg, Aarhus University / Department of Bioscience; J. Fritt-Rasmussen, K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment In case of an acute oil spill response operation, decision making regarding the operational response strategy and prioritizing biology at risk must be resolute. For that a Net Environmental Benefit Analysis, NEBA, is often performed to achieve the optimal environmental benefit with respect to choice of oil spill combat methodology and biology at risk. To provide data for assessing the affecting oil spills impacts in the Arctic areas, the effects of oil smothering of the macroalgae Fucus distichus, which is a dominant species in the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea, were studied. Effects of four different oil types were tested, including crude oil types, bunker oil and marine dispersant oil types at concentrations ranging from 0 to 68 µg/L, to test the origin of crude oil and refinery process, and hence may have different effects due to their physical and chemical characterizations. Photosynthetic activity was measured as proxy for effect on growth and the self-cleaning potential was tested by wash in sea for oil smothered tips of F. distichus over a period of 2 weeks. The removal of the oils from the seaweed surface was considered as relatively fast (T½ = 3 – 4 days).
Depending of oil type, the oil inhibited or stimulated photosynthetic activity. Marine diesel inhibited photosynthetic activity, whereas the three other oil types stimulated the activity. Thus, in general, the results indicated 1) that oil smothering was relatively fast washed off in the sea water; 2) that, depending on the oil type, photosynthetic activity were stimulated or inhibited; and 3) that the photosynthetic activity was still affected (stimulated or inhibited) even after 14 days, although oil on the surface became insoluble. The results indicated that the NEBA approach provide information for planning the use of larvicidal oil as mosquito control pesticide and the use of larvicidal oil as mosquito control pesticide is relative fast washed off in the sea water. Also, it may be important to consider the use of larvicidal oil in the Arctic areas where the self-cleaning potential is low.

MO017 Effects of water accommodated fractions of crude oil on the Baltic Sea blue mussel Mytilus trossulus at different salinities
A. Ahvo, Finnish Environment Institute / Marine Research Centre; R. Turja, Finnish Environment Institute, SYKE / Marine Research Centre; A. Reunanen, Finnish Environment Institute / Marine Research Centre; J. Nuutinen, Finnish Environment Institute / Laboratory Centre; K.K. Lehtonen, K.S. Jorgensen, Finnish Environment Institute / Marine Research Centre
In the Baltic Sea accidental oil spills are mainly combated using mechanical collection. However, this method is insufficient in harsh weather conditions such as high waves or in the presence of ice. The use of dispersants is an alternative counteractive method but in the Baltic Sea their use is restricted by HELCOM recommendations since the chemically dispersed oil may cause severe toxic effects on marine biota. In addition, the use of dispersant to control oil spills in the Baltic Sea is not well studied. In the present study, impacts of a crude oil and the dispersant Finsol 51 on marine biota were investigated under cold conditions (5ºC) at two salinities corresponding to the German (15.0) and southern Finnish coastal areas (5.6). Baltic Sea blue mussels (Mytilus trossulus) were exposed to the water accommodated fraction (WAF) and dispersed WAF (WAF-D) of naphthenic Northern Norway crude oil in a semi-static aquarium experiment. Concentrations of WAF or WAF-D in the aquaria was 5%. The mussels were sampled after 0, 1, 7 and 21 days of exposure, and analyzed for accumulation of polycyclic aromatic hydrocarbons (PAHs), and biological effects including acetylcholinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonation. In addition, changes in Mytilus-associated bacterial communities extracted from the gills and digestive glands of the mussels were investigated by sequencing of 16S rRNA genes and quantitative PCR targeted to bacterial PAH-degradation genes. Water samples from the exposure aquaria were taken for oil and PAH analysis. Dispersant augmented the amount oil in the exposure water with 0.13 mg/l oil in 5.6 WAF compared to 44 mg/l oil in 5.6 WAF-D (GC-FID, petroleum hydrocarbons C18-C40). A significantly higher oil concentration was observed at the lower salinity WAF-D water with 44 mg/l oil at 5.6 and 1.82 mg/l oil at 15. The higher salinity and WAF-D elicited more oxidative stress and neurotoxic effects already after one day of exposure. Mytilus-associated bacterial communities also varied depending on salinity and the use of dispersant. The results indicate that during the application of dispersants salinity plays a key role by determining oil concentrations in water as well as biological effects observed in the exposed biota. This should be taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea.

MO018 Multiple biomarkers in the estuarine guppy Poecilia vivipara to monitor two Integrated approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuaries with ecologically relevant tools. The guppy Poecilia vivipara, native species with a broad tropical distribution, was utilized in such an approach, using in situ field exposures in cages
(IS) and resident individuals (RES) collected close to the mouth of two tropical estuaries, Bacia do Pina Estuarine System (BPES), and Barra de Jangada Estuarine System (BJES), in the Brazilian northeastern coastline. This study was based on the analysis of water concentrations and internal accumulation of bile metabolites of polyaromatic hydrocarbons (PAHs) by fixed fluorescence (FF), as well as biochemical responses related to the biotransformation of contaminants ethoxyresorufin-O-deethylase (EROD) activity, acrylamidine hydrolyase (ACHN), and to neuromuscular transmission acetylcholinesterase (AChE). Behavioral activities related to swimming speed and resistance were also evaluated. Individuals grown in the laboratory were used for in situ exposure and also as controls (CON) for IS and RES. Significant contamination by PAHs was evidenced from both estuarine systems, with higher phenanthrene and chrysene concentrations in the bile of resident fish at BPES, which in turn partially justified the significant induction of EROD and GST in these individuals. Resident fish at BJES showed high EROD and GST induction that cannot be explained by PAHs contamination, and suggests the presence of other contaminants with mechanisms of action similar to dioxins, possibly from a paper industry. Elevation of GST activity was detected in three of the four sites assessed on both estuaries, and loss of swimming resistance was verified on individuals exposed at the same sites, indicating a correlation between GST and this behavioral effect relevant to survival of the species. Indications of acetylcholinesterase inhibitors were not detected, except at the BPES inner region. This study shows the potential and feasibility of using the guppy *P. vivipara* on the evaluation and monitoring of pollution in estuaries along the Brazilian coast.

**MO020**

**Petroleum pollution of alluvial sediments near Sava river, Serbia**

M. Ilic, IChTM / Department of Chemistry; S. Bulatovic, Faculty of Chemistry, University of Belgrade; T. Sotilic Knudsen, IChTM / Department of Chemistry; J. Mlic, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; S. Miletic, J. Avdalovic, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; G. Devic, Institute of Chemistry, Technology and Metallurgy, University of Belgrade

Hazard plant “New Belgrade” is located on the left coast of the Sava River, about 1 km from its estuary in the Danube, and represents a potential source of petroleum pollutants for the alluvial area of the river, ground water as well as Sava river. The aim of our research was to determine the presence of petroleum pollutants and their vertical migration in the alluvial area of Sava river. The investigation was started in the summer of 2015. The soil was sampled in three different microlocations (Z1, Z3 and Z7) up to depth of 15m. The sampled material was organized in the lay of the environment. Results: Miletic S., Ilic M., Avdulovic J., Sotilic Knudsen T., Belkoski V.P., Braninmir Jovanovic B., Vrlic M.M. (2015) Oil pollution in the vicinity of a heating plant in New Belgrade (Serbia) – influence on the quality of the surrounding soil and sediments. 16th European Meeting on Environmental Chemistry, EMEC16, Book of Abstracts. November 30 – December 03. 2015. Torino, Italy. Acknowledgements This work was supported in part by Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No: III 43004.

**MO021**

**Prey capture to male aggression: the role of ecologically relevant behaviours in the assessment of complex petroleum based contaminants.**

D. Philibert, University of Alberta / Biological Sciences; D. Lyons, C. Philibert, University of Alberta; K. B. Tierney, University of Alberta / Biological Sciences

Crude oil and its associated by-products are ubiquitous in the aquatic environment due to both natural and anthropogenic sources (i.e. oil seeps and rivers flowing over surface bitumen, and pipeline ruptures, grounded ships, storage tank leaks and accidental spills). The evaluation of the potential impact of petroleum and its derived by-products on fish and other aquatic organisms is a major concern to many countries, with particular attention directed to assessing the potential risk they may impose to aquatic ecosystems. Although exposure to crude oil and its derived by-products has been associated with varied effects on fish, the relevance of these effects to the assessment of petroleum contamination is complicated by the presence of mixtures of complex pollutant mixtures, including weathered and unweathered oil, unconventional oil, such as diluted bitumen (dilbit), and crude oil extraction-based mixtures, such as oil sands process water (OSPW). Historically, studies focused on lethality and cardio-toxicity; complex behaviours have been, for the most part, overlooked despite the merits of including these endpoints in toxicological studies. In the present study, we compared the toxicity of two oil derived mixtures (pure crude oil and/owl) with gasoline. It is intended to validate the performance liquid chromatography coupled to diode array detection (HPLC-DAD) for the determination of BTEX in soil samples. A methodology was developed using as mobile phase methanol and H2O acidified with 250μL of H3PO4 (70:30, v/v), Xylene XDB C18 column (5μm x 4.6 x 250mm), flow of 1.5 ml min⁻¹, λ= 205nm and T = 50 °C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a column oven, and a diode array detector using the software OpenLAB A.01.05 software. A calibration curve for BTEX standards was constructed in 7 concentration levels: 1 to 68 ppm for benzene, 1 to 80 ppm for toluene, 1 to 80 ppb for ethylbenzene and 1 to 85 for xylene. The curves were submitted to intra- and inter-assay repeatability analyses. Standard curves with adjustments above 0.991 relative standard deviations (% RSD) of less than 1.9% were obtained.

Reproducibility tests were performed with two solutions obtained from the standard solution. In the samples containing analytes from the soil contaminated with gasoline, % RSD was obtained below 6.5% and recovery rate was 68% for benzene and 75% for toluene, 78% for ethylbenzene and 78% for xylene. The method of soil analysis via HPLC is therefore efficient and as an alternative to be highlighted for the analysis of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and apply it in contaminated areas for the verification of BTEX levels in the next step.

**MO022**

**Risk-Based Approach: Assessment of Offshore Discharge Waters**

K. Wadhia, National Oilwell Varco (NOV) / Environmental; O. Pelz, BP / Gulf Coast Restoration Organization; S. Cousins, BP

In 2012, OSPAR (Oslo and Paris Conventions) adopted the recommendation 2012/5 for a ‘Risk-Based approach’ (RBA) to the management of Produced Water (PW) discharges from offshore installations’. The application of the RBA recommendations (2012/5) is implemented by the UK’s regulator, the Department for Business, Energy and Industrial Strategy (BEIS). The objective of the RBA is to assess the environmental risk of a PW discharge in the OSPAR maritime area. This is achieved by analysing the effluent and added substances to obtain a measure of the toxicity of the discharge using a contaminant mixture toxicity (CMTox) approach for Oil RBA. In 2014, DECC and HM Treasury established a Risk Based Assessment (RBA) Working Group (PW WEA) with the aim of developing a PW Management Plan (PWMP). The first task was to establish a risk assessment framework that could be used in the risk assessment of contaminant mixtures. The inclusion of complex behaviours in toxicological studies brings ecological relevance to a biomarker dominated field.

**MO009**

**NEW METHOD TO DETERMINE BTEX IN SOIL SAMPLES BY HPLC-DAD**

L. Silva, Universidade Federal do ABC / PROGRAD - CLD; C. da Silva, E.C. Lima, UFABC / CCNH; D. Rosa, UFABC / CECS

Benzene, toluene, ethylbenzene and xylene, commonly referred as BTEX, are components of gasoline and as such cause diverse negative impacts on the environment and human health. At fuel stations where storage tanks are leaking, these substances may in contact with the soil and even reach the groundwater. In order to detect the concentration of these compounds in contaminated soils, gas chromatography (GC) is the most commonly used technique. In the present work it is proposed the use of high performance liquid chromatography coupled to diode array detection (HPLC-DAD) for the determination of BTEX in soil samples. A methodology was developed using as mobile phase methanol and H2O acidified with 250μL of H3PO4 (70:30, v/v), Xylene XDB C18 column (5μm x 4.6 x 250mm), flow of 1.5 ml min⁻¹, λ= 205nm and T = 50 °C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a column oven, and a diode array detector using the software OpenLAB A.01.05 software. A calibration curve for BTEX standards was constructed in 7 concentration levels: 1 to 68 ppm for benzene, 1 to 80 ppm for toluene, 1 to 80 ppb for ethylbenzene and 1 to 85 for xylene. The curves were submitted to inter- and intra-assay repeatability analyses. Standard curves with adjustments above 0.991 relative standard deviations (% RSD) of less than 1.9% were obtained.

Reproducibility tests were performed with two solutions obtained from the standard solution. In the samples containing analytes from the soil contaminated with gasoline, % RSD was obtained below 6.5% and recovery rate was 68% for benzene and 75% for toluene, 78% for ethylbenzene and 78% for xylene. The method of soil analysis via HPLC is therefore efficient and as an alternative to be highlighted for the analyses of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and apply it in contaminated areas for the verification of BTEX levels in the next step.

**MO003**

**Produced Water Management Methodology: Inference of use of different trophic level species, including weathered and unweathered oil, unconventional oil, such as diluted bitumen (dilbit), and crude oil extraction-based mixtures, such as oil sands process water (OSPW).**

Previous studies suggest that cortisol can be associated with behavioural phenotypes, and that developmental cortisol levels may pre-determine the behavioural phenotypes found in a population of exposed fishes. Complex behaviours are sensitive sublethal endpoints that could be used in the risk assessment of contaminant mixtures. The inclusion of complex behaviours in toxicological studies brings ecological relevance to a biomarker dominated field.
MO023
Risk-based assessment of produced water discharges - need for alignment
M.G. Smig, Shell International
Produced formation water is the main waste stream from upstream oil and gas activities. For offshore installations, next to produced water reinjection (PWRI), discharge of treated produced water is a commonly used disposal route applied in line with ALARP principles (As Low As Practicable, Rea) in order to properly manage produced water discharges. A variety of principles have been adopted in national and international regulatory frameworks focusing on e.g. the oil in water content, toxicity of produced water, PBT characteristics of applied offshore chemicals, environmental monitoring, etc. The onus is on the industry to comply with regulations in the country of operation, to properly manage the risk of produced water discharges and to relieve any concerns over the potential environmental effects in the receiving marine environment. For this purpose the industry is applying a diversity of tools and methods within the framework of risk-based assessment (RBA). Tools and methods range from simple (tier 1) screening tools to comprehensive (tier 3) field verification programs and include among others: chemical analysis, determination of PBT characteristics through whole effluent toxicity (WET) and modelling, dilution screening and 3D dispersion modelling, etc. Within those practices a wide range of risk endpoints are being applied, each with their own level of conservatism. Without harmonization of endpoints it is difficult to interpret when risks can considered to be adequately controlled. For example, different approaches base the assessment on either chronic or acute toxicity data. And where one method considers an acceptable mixing zone of 50m, another might accept 100m (US-EPA). This hampers straightforward comparison of results of risk-based assessments across industry and regulatory frameworks. Different objectives of the assessment undertaken might, however, be a reason for existing differences in methods. It is, therefore, crucial that for each assessment method a corresponding assessment objective is formulated and communicated. This presentation will provide an overview of RBA practices currently being applied by the industry to offshore produced water disposal, showing main assumptions, input requirements, risk endpoints applied and corresponding assessment objectives. Examples will be used to highlight the need for further harmonization of approaches. Development of industry guidance including a common tiered framework for RBA is suggested as a first step to achieve this.

MO024
Spatial and temporal analysis of the risks posed by total petroleum hydrocarbon and trace element contaminants in coastal waters of Kuwait
E.E. Nicolaou, Cefas Lowestoft Laboratory / Environment and Ecosystems
Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb, V and Zn, and total petroleum hydrocarbon (TPH) concentrations were analysed for water samples collected from 23 stations since 1984 from Kuwaiti coastal waters. Here it was investigated whether concentrations of these determinands are at levels above Kuwaiti and internationally established assessment criteria (AC). The results indicate that Cu and Cd had the most Kuwaiti AC breaches over time. Comparing the data of the last sampled year to the least stringent international AC, then Cu and Cd showed breaches at all stations. The trend in TPH concentrations was found to be significant for Cu and Cd. No determinant measured showed a significant upward trend, indicating that water pollution for these contaminants is not a worsening situation. However, further sampling should be carried out to confirm these findings, especially at shoreline locations, where routine monitoring ceased in 2011 to investigate any recent changes.

MO025
Temperature-dependant toxicity of Napthenic North Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays
L.d Miguel, University of the Basque country (UPV/EHU) / Department of Zoology and Animal Cell Biology, U. Izagirre, University of the Basque Country UPV/EHU / CBET Research Group Dep Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PEl; I. Marigomez, Euskal Herriko Unibertsitatea / Zoology & Animal Cell Biology (Sci & Tech Fac)
Maritime traffic and oil platforms in the North and Baltic Sea have been growing during the last few years. Many factors are affecting the risk of spill and the risk of serious contamination has increased. Changes in water temperature could modify the potential toxicity of spill products including chemical dispersants. The impact of crude oil water accommodation fraction (WAF) and dispersants have been widely studied but their potential toxic effects at different range of temperature have not been deeply explored yet, to our knowledge. Thus, as a part of a European project called GHIBUS (which is the present work was as a part of), the potential toxicity of WAF produced from: Napthenic North Sea crude oil (NNS), Finasol OSR52 dispersant (Total Fluids) and their mixture (NNS+Finasol OSR52) in a wide range of temperatures (5, 10, 15, 20 and 25°C). In order to identify temperature-dependant toxicity, acute toxicity bioassays using larvae and embryos of the sea urchin Paracentrotus lividus (Lamark) were performed. After the exposure period, EC50s and EC90s were calculated to assess the inhibition of larval growth. Additionally, larvae abnormalities were determined to calculate a general index of toxicity (IT). In the present study, at 25°C NNS WAF provoked a lower inhibition of larval length than the other studied temperatures. Accordingly, oil toxicity seems to be influenced by temperature. Indeed, temperature is known to affect hydrocarbon solubility and evaporation, and dispersant effectiveness. The same trend was found for Finasol OSR522 WAF. However, high temperature seems not to follow the same pattern in the case of the mixture. EC50 and IT values were in accordance showing that dispersion increases WAF toxicity. Overall, results showed that temperature affects oil, oil/dispersant and chemical dispersant toxicity. In the study, larvae abnormalities and reduced larval growth indicate that toxicity was lower in crude oil WAF than in dispersed WAF, with their mixture in between, for all the temperatures tested. Acknowledgement – This work has been funded by the EU H2020-BG-2005-2 project GRACE (grant agreement number 679266), Spanish Ministry of Education, Culture and Sport (PhD fellowship L.D.M PP15/05317 grant) and the Basque Government (Consolidated Research Group GIC17T13-13).

MO026
Temporal variability of acute toxicity of Produced Formation Water discharged from offshore platforms: the responses of sea bass (Dicentrarchus labrax L., 1758) larvae
L. Mariani, CNR-IRSA / RSA; E. Magaletti, B. Di Lorenzo, F. Onorati, C. Vinro Lamberti, ISPRA Institute for Environmental Protection and Research The Higher Institute for Environmental Protection and Research (ISPRA) is responsible for the evaluation of the potential environmental impact on marine ecosystem caused by the Produced Formation Water (PFW) discharged from Italian gas offshore platforms. A multidisciplinary approach has been applied through the monitoring of chemical-physical characteristics of water and sediment, matched with biological investigations, such as ecotoxicological bioassays on bacteria, algae, rotifiers, crustaceans, echnodinids and fishes. The PFW is a effluent containing complex mixtures of contaminants, the composition of which may change with time. It is therefore necessary to analyse a large number of samples taken over a long period of time in order to adequately assess the toxicity of this effluent. The present paper is focused on one specific toxic fraction within the whole study: the variability of the acute toxicity responses of fish to PFW collected on two offshore gas platforms in three years (2003-2005). More sensitive life stages (post larvae of 25-45 days old) of European sea bass (Dicentrarchus labrax L., 1758) were used. Tests were performed over 24h and 96h and the dilutions 6.25-12.5-25-50.0-100.0 % PFW were used. The LC50 values on post larvae ranged from 17.67 % to 37.42 % PFW. The LC50 values on post larvae ranged from 6.68 % to 16.51 % PFW. The PFW acute toxicity responses showed a temporal variability of PFW as it is highlighted by standard deviation values of LC50 data: exposure 24h (25.61 ± 7.022 % PFW); 96h (10.84 ± 3.37 % PFW).In accordance with GESAMP recommendations (2007), the work stresses the importance of accurate estimates and measures of oil inputs into the sea, by increasing the number and frequency of samples needed to estimate the environmental hazard of PFW.

MO027
Tentative identification of halogenated polycyclic aromatic hydrocarbons in biota
Z. Xia, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; W. Johnson, University of Manitoba / Chemistry; O. Francisco, I. Idouw, University of Manitoba; J. Stettefeld, University of Manitoba / Chemistry; G. Tenny, Department of Fisheries & Oceans / Department of Chemistry Polycyclic aromatic compounds (PACs) are a complex class of compounds that are present in fossil material such as petroleum oils. The most common PACs are the polycyclic aromatic hydrocarbons (PAHs). The particular PAHs that are of concern are priority compounds by the United States Environmental Protection Agency. However, there are other important PACs that to date have received less attention. These include halogenated PAHs, non-halogenated alkylated PAHs and heterocyclic aromatic compounds that contain S-, O- and N-atoms. Halogenated PACs especially those containing chlorine atoms are likely to be more environmentally persistent than their non-halogenated analogues because of the presence of the halogen atoms. In addition, the toxicity of some halogenated PAHs have been found to be similar to dibenzo-p-dioxins and dibenzofurans. Because Cl and Br ions are present in the marine environment, we hypothesize that halogenated PACs can be formed and will be bioaccumulate in biota samples. Here we present a method based on high resolution quadrupole mass spectrometry coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ion transitions in the electron ionization mode to detect and quantify halogenated PACs in biological samples. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. Preliminary results show that 1-chloropyrene is present in this sample. In addition, we have observed multiple peaks in the mass chromatograms coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ion transitions in the electron ionization mode to detect and quantify halogenated PACs in biological samples.

MO028
The experience with the use of biomarkers as Risk Indicators in Environmental Risk Assessment of oil based discharges offshore
S. Sanni, International Research Institute of Stavanger / Environment; E. Lyng, D.M. Pampanin, International Research Institute of Stavanger / Environment
Department
An approach to integrate biomarkers into probabilistic risk assessment has recently been developed and published regarding oil based discharges offshore. The main purpose has been to enable the use of measured biomarker responses offshore as Risk Indicators in the procedures for Environmental Risk Assessment of produced water (PW) discharges. The principles of the approach and experiences obtained in applying it to existing oil field monitoring data will be presented. The approach was tested by evaluating a number of different arrays of data from the latest surveys in the biomarker based oil spill reconnaissance program of the Norwegian Coastal Monitoring (WCM) program on the Norwegian Continental Shelf for assessment of PW effects. Cases including both a typical PW discharge and an alternative discharge make data the set interesting for testing the interpretation capability of the approach. At the site with no discharge of PW at the time of the surveys, the data was compared with baseline data sources of contamination. The experiences gained are discussed in relation to contaminant sources, use of the approach to provide assessment criteria for biomarkers, and for the performance of the biomarkers as risk indicators in relation to assessed environmental risk.

MO029 Tissue-level biomarkers and histopathological alterations in mussels (Mytilus trossulus) from the Baltic Sea exposed to water accommodated fractions of crude oil
J. Bir, Khulna University / FMRT department; E. Gil-Urriarte, University of the Basque country (UPV/EHU) / Zoology and Cell Biology; A. Ahvo, Finnish Environment Institute / Marine Research Centre; T. Jager, DEBtox Research / Dept of Theoretical Environmental Technology; T. Jager, DEBtox Research / Dept of Theoretical Environmental Technology; W. Robson, University of Plymouth; P. McCormack, University of Plymouth; S.J. Rowland, University of Plymouth / School of Geography Earth and Environmental; L. Faksness, SINTEF Ocean / Environmental Technology; L. Faksness, SINTEF Ocean / Environmental Technology

The Baltic Sea is a fragile ecosystem potentially sensitive to oil spills. Chemical dispersants are an effective method to mitigate coastal impacts of oil spills; however, oil treated with dispersants may have unknown toxic effects on benthic organisms. The Baltic Sea blue mussel (*Mytilus trossulus*) is a particular variety of marine mussels adapted to low salinity. Early winter mussels were collected scuba diving in Tvärminne (Finland) in November 2016, taken to laboratory facilities and acclimated at the experimental temperature of 5°C to two different salinity regimes, the local 5.6 and the artificially increased 15.0 representing the southern Baltic Sea. Mussels were exposed to water accommodated fractions (WAF) and chemically dispersed WAF (dispersant Finasol OSR 51) mixtures (WAF+D) and sampled at 0, 1, 7 and 21 d. Tissue level biomarkers were investigated to determine the following biological responses: cell type composition (volume density of basophilic cells, V_{bas}) of the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MET), mean epithelial thickness/mean diverticular radius (MET/MDR), connective/ digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MET), structural changes of digestive gland, gonad and gills. V_{bas} increased significantly after 1 d in mussels exposed to WAF and WAF+D at the salinity of 15.0, and decreased afterwards. MET/MDR changed markedly with exposure time at 15.0 whereas MET/MDR showed no response. High CTD values in mussels observed at the salinity of 5.6 indicate a poorer condition of the digestive gland at low salinities than at the higher salinities. Pathological responses (atrophy, vacuolization, haemocytic infiltration, granulocytomas) were assessed, being more evident in mussels exposed to WAF and WAF+D (21d). Salinity is a major factor controlling the biology of mussels in the Baltic Sea. The results obtained here indicate that during the early winter the health of native mussels in the very low salinity central-northern part of the sea is more easily impaired than in those inhabiting the more saline southern regions. The current study is among the first ones applying tissue level biomarkers in *Mytilus trossulus* in the Baltic Sea and provides preliminary reference values for future biomonitoring programmes in the area. Acknowledgements: Funded GRACE project (EU H2020 grant N°679266) and a Basque Gov. fellowship to EGU

MO030 Toxicity of diluted bitumen to freshwater fish and invertebrates
P.Y. Robidoux, V. Bérubé, AGAT Laboratories Ltd / Specialty services Division; J. Leblanc, Fisheries and Oceans Canada / Biologist, Contaminated Sites; M. Desrosiers, Public Services and Procurement Canada

Toxicity of bitumen and water-dispersed bitumen ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to vidfent concentrations of physically-dispersed (water accommodated fraction; WAF) and chemically-dispersed (chemically-enhanced WAF; CEDAF). Toxicity of weathered, unweathered and dispersed Access Western Blend (AWB) dilbit was evaluated on fathead mignon (Pimelnikes promelas). Toxicity of weathered and unweathered Cold Lake Blend (CLB) dilbit was assessed on Rainbow trout (Oncorhyncus mykiss), and two invertebrate species, daphnia (Daphnia magna) and ceriodaphnia (Ceriodaphnia dubia). For fathead mignon, unweathered AWB demonstrated a significantly higher toxicity (LC50-96 h = 0.628 g/L) compared to the weathered AWB (LC50-96 h = 2.06 g/L). Chronic toxicity tests showed that fathead minnow lethality was also higher for AWB (LC50-7 d = 0.593 g/L) compared to the weathered AWB (LC50-7 d = 1.31 g/L) whereas larval growth toxicity was lower for AWB (IC50-7 d = 0.312 g/L) compared to the weathered dilbit (IC50-7 d = 0.096 g/L). Rainbow trout exposed to unweathered CLB demonstrated a significantly higher toxicity (LC50-96 h = 5.66 g/L) compared to the weathered CLB (LC50-96 h = 1.54 g/L). LC50-96 h was also observed in ceriodaphnia exposed to the CLB WAF with no mortality was observed with the weathered CLB. The reproductive effects on ceriodaphnia were greater with the CLB (IC50 < 1.0) than with the weathered CLB (IC50 = 1.99 g/L). Volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) increased as the dilbit WAF increased.

MO031 Toxicity of produced water from offshore oil production in Norway and corresponding polar and apolar fractions
T. Starseth, A. Rootes, SINTEF Ocean / Environmental Technology; D. Altin, BioTrix; D. Altin, BioTrix

The Arctic is the oil region with the largest PW generation. After oil based discharges offshore, the main aim of this research is to use a top to bottom approach to provide assessment criteria for biomarkers, and for the performance of the biomarkers as risk indicators in relation to assessed environmental risk.

Toxicokinetics of oil components in Arctic copepods
T. Nordtug, SINTEF Ocean / Environmental Technology; T. Jager, DEBtox Research / Dept of Theoretical Environmental Technology; W. Robson, University of Plymouth; P. McCormack, University of Plymouth; S.J. Rowland, University of Plymouth / School of Geography Earth and Environmental; L. Faksness, SINTEF Ocean / Environmental Technology

The main aim of this research was to test the hypothesis that oil composition is the major factor determining toxicity mechanisms in Arctic copepods. This was done by screening the toxicity of four oil platforms on the Norwegian continental shelf. PWs were selected from oil fields of different operational ages, which produce oils exhibiting different physical and chemical properties. Samples were subjected to extraction with dichloromethane, followed by fractionation into apolar and polar fractions using solid phase extraction, recovering 80% of the total GC amenable material in these fractions. The total extracts and fractions were thoroughly characterized using GC–MS, GC–GC–MS, LC–Orbitrap–MS, and by direct infusion FT–ICR–MS. The total PW extract, as well as the apolar and polar fractions were subject to acute toxicity tests using nauplii of the marine copepod *Acartia tonsa*. LC50 values for the total PW extracts ranged between 0.05–0.98 mg L–1 (based on total GC amenable fraction analysis). For the polar fractions, the toxicity was mainly attributed to the apolar fraction, with LC50 values ranging between 0.17–0.57 mg L–1. Interestingly, toxicity was mainly attributed to the apolar fraction of the fourth PW, with an LC50 of 0.05 mg L–1. For the PWs where toxicity mostly related to the polar fraction, this fraction spanned from 16–55% of the total PW (GC amenable fraction analysis). For the PW where toxicity mostly related to the apolar fraction this was 35%. This suggests that PW toxicity is not directly correlated with the GC quantifiable compounds that are used for regulating discharges today. Further studies should be pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.

MO032 Toxicokinetics of oil components in Arctic copepods
I. Overjordet, SINTEF Materials and Chemistry / Environmental Technology; R. Nepstad, SINTEF Ocean / Monitoring and Modelling; B. Hansen, SINTEF Ocean / Environmental Technology; T. Jager, DEBtox Research / Dept of Theoretical Biology; J. Farkas, SINTEF Ocean / Environmental Technology; D. Altin, BioTrix; T. Nordtug, SINTEF Ocean / Environmental Technology

To comprehend the implications of large oil spills in the Arctic marine environment, we need a better understanding of the toxicokinetics of oil in true Arctic ecosystems. The central focus of this study is on the effect of *Thalassia homomalla* on Arctic copepods, as well as its life history strategies and Arctic adaptation, makes it a relevant and valuable test species to provide empirical data on oil component kinetics. *C. hyperboreus* of developmental stage copepodite three (CIII) and five (CV) were exposed to the water soluble fraction (WSF) of crude oil (Troll B) in continuous renewal system (4 or 8 d) followed by a recovery period (20 or 35 d). Water concentrations of dissolved and particulate organic carbon and chlorophyll concentrations were measured at intervals during the exposure and recovery period. One compartment toxicokinetic models were fitted to the experimental data to estimate bioconcentration factors (BCFs) and elimination rates (Ke). The BCFs were consistently higher for the lipid-rich CVs compared to the CIIIIs, indicating a higher bioaccumulation potential in the lipid-rich stage. The higher lipid volume fractions may explain the higher BCFs, although other factors like body size and activity levels may have contributed as well. The BCFs are well predicted by the octanol-water partitioning coefficient (log Kow). The slope of the relationship, however, differed between the lipid-poor CIIIIs and the lipid-rich CVs. For the
CIIIs, the slope was close to unity, indicating a similarity between structural lipids and octanol. The lower slope for CV signifies that storage lipids are less well represented by octanol. Elimination rates were consistently higher in the CIIIs than the CVs, resulting in a substantially longer half-time of elimination and high retention of oil components in the CVs. We discuss the role that various biological factors that may contribute to this difference.

**MO033 Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples**

I. Idowu, University of Manitoba; W. Johnson, University of Manitoba / Chemistry; O. Francisco, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; J. Stetefeld, University of Manitoba / Chemistry; C. Sandau, Chemistry Matters; T. Obal, Maxam Analytics International Corporation / Scientific Services; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry

Polycyclic aromatic compounds (PACs) and their alkylated homologues are ubiquitous and known environmental contaminants. Due to their structural diversity and complexity of alkyl-substituted PACs, the resolution of individual alkyl congeners, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two-dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and detection of PACs and their alkylated homologues were performed. The alkylated PACs were also analysed using extracts of biota, used lubricating oil and coal samples. Resolution of individual isomers of interest was observed on the 30m primary column and much more evident on the 60m column. Undoubtedly, the peak capacity and vast database of information provided by 2D-GC-HRTOF/MS for different sample matrices is an asset for the analysis of polycyclic aromatic hydrocarbons. The lower slope for CIIIs, the slope was close to unity, indicating a similarity between structural lipids and octanol. Elimination rates were consistently higher in the CIIIs than the CVs, resulting in a substantially longer half-time of elimination and high retention of oil components in the CVs. We discuss the role that various biological factors that may contribute to this difference.

**MO035 Seabird-derived contaminants and genotoxicity in Collemboia from the Arctic**

S. Kristiansen, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; H. Leinaas, University of Oslo / Department of Biosciences; G.W. Gabrielsen, Norwegian Polar Institute; D. Herze, NILU Norwegian Institute for Air Research; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

Seabirds occupy high trophic positions and due to biomagnification their bodies contain high concentrations of many anthropogenic contaminants. In the Arctic they have been shown to function as important biovectors of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutritious and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springtails (Collemboida) contribute to a high proportion of soil biomass. They have a play a vital role in biogeochemical cycling processes such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collemboia. Two Collemboia species and their habitat (soil/moss) were sampled at 7 sites with high, medium and low seabird influence in West Spitsbergen, Svalbard, and analysed for a wide range of organic contaminants, mercury (Hg), and stable isotopes of carbon and nitrogen (δ13C and δ15N, respectively). In addition, Collemboia were analysed for genotoxic responses, i.e. the amount of DNA strand breaks and micronucleus frequency. Seabird influence (indicated by δ15N) and contaminant concentrations were indicated to be higher in soil/moss sampled closer to the bird cliffs (0–150 m) compared to further away (250–400 m) within the same site. When comparing among sites, however, no association between δ15N and contaminant load was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collemboia were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs), and chlorodanes (CHLs). No association was observed between contaminant concentrations in Collemboia and habitat. DNA fragmentation was higher in Collemboia from sites with high seabird influence, compared to sites with medium and low. No differences in micronucleus frequency (MN) was found between sites or species. This is the first study on MN in Collemboia and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both δ15N and contaminant load. Seabirds increased with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

**MO036 Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013**

H.K. Midthaug, Department of Biosciences, University of Oslo / Department of Biosciences; J.O. Bustnes, Norwegian Institute for Nature Research / fram Centre; A. Polder, Norwegian University of Life Sciences / Department of Food Safety and Infection Biology; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

In these areas, springtails (Collembola) contribute to a high proportion of soil biomass. They have a play a vital role in biogeochemical cycling processes such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collemboia. Two Collemboia species and their habitat (soil/moss) were sampled at 7 sites with high, medium and low seabird influence in West Spitsbergen, Svalbard, and analysed for a wide range of organic contaminants, mercury (Hg), and stable isotopes of carbon and nitrogen (δ13C and δ15N, respectively). In addition, Collemboia were analysed for genotoxic responses, i.e. the amount of DNA strand breaks and micronucleus frequency. Seabird influence (indicated by δ15N) and contaminant concentrations were indicated to be higher in soil/moss sampled closer to the bird cliffs (0–150 m) compared to further away (250–400 m) within the same site. When comparing among sites, however, no association between δ15N and contaminant load was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collemboia were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs), and chlorodanes (CHLs). No association was observed between contaminant concentrations in Collemboia and habitat. DNA fragmentation was higher in Collemboia from sites with high seabird influence, compared to sites with medium and low. No differences in micronucleus frequency (MN) was found between sites or species. This is the first study on MN in Collemboia and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both δ15N and contaminant load. Seabirds increased with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

**MO037 Wildlife ecotoxicology: laboratory dosing studies to field**

A. Ahvo, Finnish Environment Institute / Marine Research Centre; H. Niemikoski, Finnish Institute for Verification of the Chemical Weapons Convention / Department of Chemistry, University of Helsinki; K. Straumer, Thünen Institute of Fisheries Ecology; J.A. Tornes, Norwegian Defense Research Establishment; P. Oksanen, Finnish Institute for Verification of Chemical Weapons Convention / Department of Chemistry, University of Helsinki; T. Lang, Thünen Institute of Fisheries Ecology; A. Lastumäki, K. K. Lehtonen, Finnish Environment Institute / Marine Research Centre

The sea bottom of the Skagerrak Strait (North Sea) contains ca. 45,000 tonnes of chemical warfare agents (CWA) dumped after the Second World War. Entire ships loaded with CWAs were sunk on the bottom, and these CWAs are still laying on the deep bottoms (ca. 600 m) of the area in different states of deterioration by corrosion. The current status of the CWAs in the wrecks is unknown; if released into the environment they may have significant deleterious effects on local marine biota. Within the research programme of the EU Baltic Sea Region Interreg project DAIMON (Decision Aid for Marine Munitions, www.daimonproject.com), one of these wrecks was selected to study the leakage of CWAs and their possible biological effects. From the few fish species that inhabit the studied depth range in the region, the hagfish (Myxine glutinosa), a sediment-dwelling chordate, was selected as target organism for chemical analyses of CWAs in tissues and biological effect studies. Samples were taken using bait traps near the wreck and from a reference area known to contain no CWAs. Liver tissue was analysed for oxidative stress biomarkers (including lipid peroxidation, protein carbonylation, glutathione-S-transferase, glutathione reductase and catalese activity) and for histopathological biomarkers, and muscle tissue was analysed for acetylochinesterase activity. Chemical analyses were performed from muscle samples and separate whole fish samples, and the results indicated the presence of oxidized forms of CWA-related phenylarsenic compounds in most of the muscle samples. Established biomarker methods used widely in various fish species were shown here for the first time to be applicable also in hagfish. However, only minor differences in the measured biomarker responses between individuals collected from the wreck and the reference area could be observed. Based on this study, the hagfish is regarded as a suitable candidate for ecotoxicological studies of deep marine areas. More information on the biology of hagfish and the natural variability of their biomarkers is needed to distinguish true effects of hazardous substances.
of south polar skua during the breeding season. Keywords: Antarctic, south polar skua, stable isotopes, temporal variation, OHC

MO037 Evaluation of malformations induced by a hospital effluent of Toluca (Estado de Mexico) in Lithobates catesbeianus H. Jelena-Flores, Universidad Nacional del Estado de Mexico / Toxicology Association; J. Pérez-Alvarez, Universidad Autónoma del Estado de Mexico / Environmental Toxicology; L. Gómez-Oliván, Autonomous University of the State of Mexico / Chemistry; M. Galar-Martínez, Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas; N. SanJuan-Reyes, Autonomous University of the State of Mexico / Chemistry; O. Dublan-Garcia, University Autónoma del Estado de Mexico / Biotechnology; L. Chávez-Hernández-Navarro, Universidad Autónoma del Estado de Mexico / Toxicology

Hospital effluents are important from the ecotoxicological point of view and are an important source of pollutants emission, among which are pharmaceutical products, chemical residues, radioelements, disinfectants and heavy metals, among others, which are waste of daily activities and has reported that they can reach concentrations between 4 and 150 times higher than those detected in municipal effluents. In addition to this, they usually do not have adequate pre-treatment before their emission, so they can be mixed with other effluents from homes, industries and municipal wastewater, which can subsequently generate interactions, enhance effects and create synergies, which lead to induce adverse effects on the environment. So it is important to study. The Estado de Mexico is located in the center of the country and is considered the entity with the largest population and according to data reported in 2015, it has 1835 medical units of different levels of care. On the other hand, Lithobates catesbeianus is a species considered native of the state and has been proposed by the government as an alternative to food supplement (due to its protein content). Due to the aforementioned, the objective of this work was to evaluate the malformations generated by a hospital effluent of Toluca (Estado de Mexico) in this species and compare with Xenopus laevis, a species that is used as a preferred bioindicator, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose oocytes in mid-blalstula transition were exposed for 96 h to six different concentrations of the effluent (0.1, 0.3, 0.5, 0.7, 0.9 and 1%), subsequently, the mean lethal concentration (LC50) effective concentration inducing 50% malformation (EC50), and the teratogenic index (TI) was obtained. Results indicates that lower concentrations of the hospital effluent induced slightly higher malformations and lethal effects in X. laevis (EC50=0.132%, LC50=0.508%, TI=3.8) and in L. catesbeianus (EC50=0.351%, LC50=1.431%, TI=4.0), the main alterations being microcephaly, cardiac and facial edema, malformations in the eye, notochord, tail, fin and intestine. However, the lightest concentrations of 0.1 and 0.3% did not indicate any effect on oocytes exposed to this hospital effluent will be malformed in the absence of mortality compared to X. laevis. and therefore, can be considered as a sensitive and useful species to evaluate toxic effects of contaminants with the FETAX assay.

MO038 Monitoring fish health in a densely populated catchment in Central Germany M. Schweizer, University of Tuebingen / Animal Physiological Ecology; A. Dieterich, S. Betz, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; N. Corral Morillas, Eberhard Karls Universität Tübingen; C. Dewald, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; D. Leim, Eberhard Karls Universität Tübingen; L. Miksch, S. Nelson, V. Prozmann, J. Rössel, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; R. Triebkom, University of Tuebingen / Animal Physiological Ecology; H. Köhler, University of Tübingen / Animal Physiological Ecology

In the frame of the joint project NiddaMan coordinated by the Goethe University Frankfurt/Main we investigated health parameters of fish from the River Nidda and its tributaries Horloff and Usa in Central Germany. The Nidda river system is regarded as a typical river system for central Europe as it passes a very densely populated area and as it is heavily influenced by anthropogenic factors including agriculture, communal waste water and industrial discharges. To get a broad overview of the situation fish face in this river system and the resulting effects, we investigated biological parameters on different levels: (I) Evaluation of water and sediment characteristics regarding metals, nutrients, and contaminants; (II) Evaluation of food web characteristics regarding biodiversity, fish abundance, fish biomass, and otoliths analysis; (III) Evaluation of fish health parameters (morphological, histological, histochemical, biochemical, genome wide, proteome wide) regarding health status and stressing factors; (IV) Evaluation of early warning and monitoring systems for fish and other organisms regarding ecosystem health. Results show that the river system – from a biological point of view – is not in a good (as pointed out by the EU Water Framework Directive) but rather in a moderate to unsatisfactory condition throughout most of its stretch, whereas upstream areas mainly perform worse than sampling sites downstream. This is noticeable in results obtained by the Dar-T, in particular. However, histopathology of the liver from monitored fish upstream and downstream in general showed vacuolisations, inflammations, haemorrhages in the tissue, and even some necrosis. Our results revealed that, in the case of the Nidda and its tributaries, there is an urgent demand for action to strongly improve the biological integrity of this system.

MO039 Multigenotypical toxicity of Fipronil to Folsomia candida D.d. Oliveira, C.M. Reganhan Congelani, SCHOOL OF TECHNOLOGY UNICAMP; V.B. Menezes-Oliveira, Universidade de Sao Paulo / Department of Hydraulic and Sanitation

Fipronil is a pesticide widely used on agricultural pest control, especially in sugarcane crops. This compound acts as an inhibitor of nerve signals in insects, and pose as a risk to non-target terrestrial organisms (i.e. the coelomoblast Folsomia candida), which plays important roles in the maintenance of soil quality. The main objective of this study was to evaluate the ecotoxicological effects on the reproduction of three generations of the Folsomia candida species when exposed to fipronil over time, under a natural tropical soil. Test procedures were adapted from the ISO 11267 guideline. The chosen concentrations of fipronil were based on the recommended doses (RD) for the control of the pest Migodulus frymues in sugarcane crops (RD = 1.3 mg of the commercial product / kg of dw soil), which means 1.04 mg of fipronil / kg dw soil. Concentrations tested were 0.06; 0.13; 0.26 and 0.52 mg fipronil kg-1 of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (± 0.001 ± 0.001 kg) of soil, for the first, second and third generation, respectively. According to the results, fipronil showed significant toxicity at low concentrations up to the third generation, causing effects on the reproduction and survival of Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO040 Fipronil effects on freshwater benthic algal communities J. Val, D. Ballesteros, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos revanales; J. López-Martinez, A.M. Mainar, Universidad de Zaragoza; M. Pinto, San Jorge University / Facultad ciencias de la salud

Fipronil is a widely used broad-spectrum phenylpyrazole insecticide, effective against insects resistant to other agents as pyrethroids, organophosphates or carbamates. Accordingly, it has gained popularity worldwide as a pesticide in both agricultural and urban environments. Its wide use, resulted in the presence of fipronil in soil, surface and ground waters involving a risk to the environment and humans. In addition, humans and animals are also exposed to fipronil, by ingestion of products containing residues. Previous studies showed the toxicity of fipronil to aquatic freshwater organisms using model species, but there is scarce information about its impact on wild organisms. This study assesses, for the first time, the impact of fipronil on the photosynthesis of natural freshwater algal benthic community. This community – periphyton- is a key element of aquatic trophic chains, and is routinely used as indicators of water quality. Results show LC50 values of 0.74 mg/l (6.3-0.89) (p<0.001), exposing periphyton to fipronil under standard medium. However, toxicity was almost inexistent when assays were done using natural river water. In this last case, the bioavailability of the fipronil was hypothesized to be reduced by natural substances present in the river water (solid suspended solids, organic matter, etc.). These results would contribute to a more realistic assessment of the environmental impacts of the use of this kind of pesticides.

MO041 Use of organophosphorus insecticides in agriculture lands, in a simple test birds says please no A. N. HUUD LEON, Universidad Juarez del Estado de Durango / Facultad de Medicina Veterinaria y Zootecnia; M. Pereda Solís, Universidad Juarez del Estado de Durango / FMVZ; J.H. Martinez-Guerrero, Universidad Juarez del Estado de Durango / Facultad de Medicina Veterinaria y Zootecnia; M. GUERRERO CERVANTES, Universidad Juarez del Estado de Durango / FMVZ

Due to the human population increase and the consequent high demand for food, each day a larger area of the planet is dedicated to the practice of agriculture. Crops favor the reproduction of various organisms (invertebrates and vertebrates) that are combated with large amounts of pesticides, it is chemical compounds used extensively, and so all organisms are exposed from different sources such as food, water and soil, therefore the toxicity of agrochemicals, as well as the patterns of use and consumption that is made of them are of great environmental concern. In the case of the biodiversity of agroecosystems. The main pesticides used in agriculture are organophosphates (OP), they are highly toxic. In birds, the main route of intoxication to OP is through the consumption of contaminated food, although it can also occur by inhalation when flying over or inhabiting the crop fields and its surroundings. The OP affects the nervous system by inhibiting the function of acetylcholinesterase, which is responsible for transforming the neurotransmitter acetylcholine into choline and acetate. A decreased level of cholinesterase (ChE) activity in the animal tissue is a strongly indicative sign that some type of exposure to an inhibitory agent of this enzyme has occurred. Our objectives were to document ChE levels in house sparrows in response to their exposure to an OP product used in agriculture and determine the extent of their negative effects on birds. In the University Campus (UEID, Durango, Mexico), we collected 19 house sparrows and serum ChE activity was determined by spectrophotometry before and after the consumption of food treated with malathion. The results show a ChE inhibition (11.58 %) after treatment (p = 0.03), also we observed nonsignificant
relationships (Pearson, R²=0.11) between the ChE and the weight or sex of the birds. The weight of the birds decreased on average 1.54 g after the exposure, possibly due to the stress of capture and the lack of adaptation to captivity. The house sparrow showed to be a species sensitive to the presence of OP compounds in the environment. It is possible that the house sparrow and other birds that co-inhabit the agricultural areas where malathion is applied, as well as other OP insecticides, are prone to develop different levels of intoxication and that in some cases their health condition is compromised.

**MO042 Implementation of a worst-case landscape scenario for population modelling of a fungicide applied in cereals**

M. Wang, WSC Scientific Group / Dept Efate; Modelling; T. Preuss, Bayer AG / Environmental Safety; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team

In many cases EU member states prefer the use of country specific scenarios for the exposure or risk assessment of pesticides. This is sometimes requested due to specific geographical features or agricultural practice. In the present example, we demonstrate how the specific agricultural situation of the Netherlands was taken into account for the selection of landscape scenarios for use in population modelling. It is first shown how a country specific landscape scenario is developed. Then, the dose response obtained in a rat reproduction study with an azole fungicide is employed in a population-level risk assessment on small herbivorous mammals (Common vole, Microtus arvalis). The margins of safety obtained in that assessment were found to be rather low. For example, no non-lethal effects were observed in the animals collected from the area of concern. Under realistic worst-case field conditions, the dose obtained non-lethally correlated significantly with blood levels for the case of Pb (Pearson, R²=0.11) between the ChE and the weight or sex of the animals. These individuals showed the highest levels of Hg were detected in the animals collected from the area of concern. This relationship (Pearson, R²=0.11) between the ChE and the weight or sex of the birds. The weight of the birds decreased on average 1.54 g after the exposure, possibly due to the stress of capture and the lack of adaptation to captivity. The house sparrow showed to be a species sensitive to the presence of OP compounds in the environment. It is possible that the house sparrow and other birds that co-inhabit the agricultural areas where malathion is applied, as well as other OP insecticides, are prone to develop different levels of intoxication and that in some cases their health condition is compromised.

**MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals in farming areas**

L. Pérez-Carrera, IREC-UCLM / IREC-UCLM; A. Rodriguez-Perez, UCLM-IREC; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; M. Ortiz Santaliestra, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM

The mobilization of metals and mercury to the earth’s crust due to anthropogenic activities, such as mining, is one of the main contamination routes for wildlife. With the objective of biomonitoring and validating non-invasive methods for metal analysis in reptiles, levels of lead (Pb) and mercury (Hg) in blood, faeces and carapace scales of freshwater turtles (Mauremys leprosa, n=86) from historical mining areas (i.e. Valle de Alcudia-Sierra Madrona district for Pb, Almadén district for Hg) were analysed. The highest levels of blood Pb were found in the animals collected from the area of Alcalá de Alcudia-Sierra Madrona, more specifically from Solana del Pino, with an average (±SD) of 5.59±3.66 μg/dl. Individuals from this location showed the clearest evidences of oxidative stress, as estimated from the highest values of malondialdehyde (biomarker of lipid peroxidation) and superoxide dismutase activity. However, no correlations were found between blood levels and mercury exposure. The analysis of the currently available data. The examination of several biochemical markers is needed to evaluate the ecotoxicological risk of amphibians within the remit of the PPP authorization.

**MO045 European common frog (Rana temporaria) larvae show subcellular responses upon field-relevant Bacillus thuringiensis var. israelensis (Bti) exposure used in mosquito control**

S. Allgeier, B. Frombold, University Koblenz-Landau; V. Mingo, Trier University / Biogeography; C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences

Bacillus thuringiensis var. israelensis (Bti) is presumed to be an environmental-friendly insecticide for use in either health-related mosquito control or the reduction of nuisance associated with mosquitoes coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to Bti products several times during their breeding season. Up until now, information regarding effects on the non-targeted group of amphibians has to be regarded rather inconsistent. On this account, we evaluated how repeated exposures to frequently used Bti formulations (VectoBac®2AS, VectoBac®WG) in field-relevant rates affect European common frog (Rana temporaria) larva. In a laboratory approach, tadpoles experienced exposure conditions similar to realistic mosquito control in the Upper Rhine Valley (Germany). We assessed potential effects with regard to enzymatic biomarkers (glutathione-S-transferase, glutathione reductase, acetylcholine esterase), development, body condition and survival until the end of metamorphosis. Regardless of the formulation, delivery form or application rate, tadpole survival rates and time to metamorphosis were slightly reduced after repeated Bti exposures, while body condition was similar throughout the treatments. Furthermore, Bti induced significant increases of all enzymatic activities irrespectively of the applied field rate and formulation, indicating oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bti applications, especially acting on early developmental stages, seem to increase the risk for adverse effects. The examination of several biochemical markers is needed to evaluate the ecotoxicological risk of Bti for amphibian populations, especially in the context of worldwide amphibian declines. Following the precautionary principle, the implementation of certain thresholds for application numbers and intervals should be considered in order to ensure environmentally friendly mosquito control programs, especially in areas originally designated for nature conservation.

**MO046 Influence of salinity and temperature on tadpoles of Xenopus laevis**

C. Monforte, R. Alves, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to the effect of seawater intrusion. Coastal wetlands are particularly important for the conservation of biodiversity and represent relevant ecosystems for amphibians. This class of vertebrates holds the highest proportion of endangered species and is considered very vulnerable to salinity changes. In this context, the present study aimed at evaluating the influence of temperature on the adverse effects that increase of salinity may cause to tadpoles of the amphibian species Xenopus laevis. To address this objective, X. laevis tadpoles (Gosner 25) were exposed to a range of 5 NaCl concentrations under three temperatures: 20, 23 and 26°C. The following parameters were monitored at the end of the test: feeding rate, body weight and growth rates. The differences reported for size between control and NaCl concentrations were mainly due to the tail length. For all concentrations, the feeding rate decreased with increasing NaCl concentration. As well, body weight decreased

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with increasing salinity. Although significant interactions between temperature and salt concentration were registered, a pattern of influence in the temperature was not observed. Adverse effects were observed at the lowest tested salinity levels, which suggest that these species are highly vulnerable to small salinity increases and would be at high risk under seawater intrusion scenarios. Keywords: Salinity; toxicity; amphibia

MO047 EFFECTS OF THE EXPOSURE OF LARVAS OF Dendropsophus columbianus (ANURA: HYLIIDAE) TO WATERS CONTAMINATED BY ANTHROPOCENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES

V. Rodríguez-Castro, Universidad de Caldas; B. Toro, Universidad de Caldas / Biological Sciences

The pollution generated by agriculture, livestock and mining have impacted the watersheds in the Colombian Andes. Amphibians have been used to evaluate this contamination due their biphasic lifecycle, which has made them ideal models in aquatic ecotoxicology. The objectives of this work were: 1) to determine if tadpoles of D. columbianus exposed to contaminants of agricultural, livestock and mining (with mercury: Hg, and with mercury and cyanide: Hg/CN) varied in the snout-vent length (SVL), tail length (TL), head width (HW), and body weight, and 2) to evaluate the effect of exposure on metamorphosis and behavior of the larvae. The AMPHITOX protocol was followed using ten larvae in each of the treatments and in the control, which were exposed from the moment of hatching to complete metamorphosis. Significant differences were found in the LRC between the larvae of the control and the Hg/CN mining treatment (Z = -28.92, p = 0.000) and between Hg/CN mining and agriculture treatments (Z = 25.325, p = 0.001) after 50 days of exposure. Differences in LC were found between the larvae of the control and the Hg/CN mining treatment (Z = -25.57, p = 0.001), and between Hg/CN mining and Hg/CN mining treatments (Z = 21.525, p = 0.009) in the same time. The weight did not show differences. The majority of larvae of the control and the agriculture treatment showed similar development rates, reaching stage 46 between days 60 and 75 of exposure. While tadpoles exposed to Hg/CN mining did not complete the metamorphosis and reached stage 42 between days 50 and 55. Surface flotation was the activity that was most stable at the time of exposure, presenting percentages of individuals greater than 60% in the control (81%), and in the agriculture (70%) and Hg mining treatments (65%), between the last days of exposure evaluated: 22 to 28. It is shown that 1) the effects on growth of anuran larvae due to agricultural, livestock and mining contamination are similar. However, samples contaminated by mining produce smaller tadpoles than agriculture and livestock, and 2) tadpoles exposed to agricultural and livestock contamination, unlike other studies which registered times of metamorphosis, show a time of this process that approximates to the time that the species experimented in the control (134 days) and probably, to the time of this in situ.

MO048 Risks for amphibians and reptiles by dermal exposure to pesticides

F. Stransmil, EFSA / Pesticides Unit; P. Adrianius, Alterra Wageningen University and Research Centre; R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece

Amphibian and reptilian species are found in agricultural landscapes. Some inhabit water bodies either permanently or during some time of their life cycle. Others use predominantly terrestrial environments. Some amphibians and reptiles show a pattern of migration that involves changes to different environments, e.g., during the mating season. Amphibians and reptiles are considered sensitive species that are highly vulnerable to toxicants. Although it is known that a large number of pesticides are used in agricultural landscapes, there are no studies available that address the risks to amphibians and reptiles of these pesticides. The aim of this study is to evaluate the dermal exposure of amphibians and reptiles to the active ingredients of pesticides commonly used in agricultural landscapes in Europe, with a focus on the aquatic environment. The analysis of the risk to amphibians and reptiles was performed at two different levels: (1) to determine the potential risks associated with the overall use of pesticides and (2) to provide more detailed assessment of the use of pesticides in specific agricultural landscapes. The results showed that the highest risk to amphibians and reptiles is associated with the use of pesticides containing organophosphates (e.g., chlorpyrifos, chlorpyrifos-methyl, fipronil, and pirimicarb) and pyridine derivatives (e.g., acetylcholinesterase inhibitors). These results suggest the need for further research to better understand the risks associated with the use of these chemicals in agricultural landscapes.
non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians and reptiles. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. Reptiles have very little data with which to assess the coverage of important life stages and exposure routes. Current knowledge suggests that surrogacy based on bird or mammal data may not be appropriate for the juvenile and adult stages of reptiles, though data are very limited. Reptile eggs are not covered by any aspect of the current risk assessment paradigm, but it is unknown to what extent reptile embryos lay eggs in crop fields, and how likely exposures are to occur to eggs under realistic scenarios. Therefore, more data are needed to determine if this is a vulnerable life stage that needs specific consideration. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to reptiles were supported after the analysis of the current available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of reptiles within the remit of the pesticide authorization. MO052
AmphioMove: Moving patterns and microhabitat selection of European anurans in agricultural landscapes
The current decline of amphibian populations on global and local scales is discussed by scientists around the world. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFSA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecology (aquatic and terrestrial life-stages in different environments) make amphibians a particularly important vertebrate group to see in agricultural landscapes. It is emphasized that detailed ecological data of especially terrestrial amphibians is still under-represented but required for a comprehensive risk evaluation of all amphibian life-stages. The aim of this project AmphioMove is to fill the data gap on terrestrial life-stages in a European framework with focus on moving patterns and microhabitat selection in agricultural landscapes. At two study sites individuals of common toads (Bufo bufo) and common frogs (Rana temporaria) were caught at and around their breeding ponds, fit with a transmitter and afterwards tracked via radio-telemetry. Locations, biotic and abiotic parameters of the selected microhabitats were recorded daily. We show preliminary results of the first period of data collection for common toads from March to October 2017.
MO053
A quantitative AOP for activation of the aryl hydrocarbon receptor leading to early life stage mortality in amphibians and reptiles
A. Scudiero, J.P. O'Malley, Institute of Food, Science and Technology; J.A. Doering, US EPA / Mid Continent Ecology Division; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; M. Martín-Haro, Institute of Game and Wildlife Research (IREC) / ICREM - UCLM; M. Martin-Haro, Institute of Game and Wildlife Research (IREC) / UCLM-ICREM; R. Ribeiro, Universidade de Coimbra / Life Sciences; R. Mateo, IREC-CSIC / UCLM / Grupo de Toxicología de Fauna Silvestre; J. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro The aims of this work were to 1) determine oxidative stress and metal burden in anuran tadpoles from historically metal exposed populations (Hg/Pb), and 2) assess if tadpoles from impacted sites have increased tolerance to metals relative to tadpoles from reference sites. Metal body burden, oxidative stress biomarkers and metallothioneins (MT) were measured in Pelophylax perezi tadpoles from reference and metal contaminated sites. Additional tadpoles (20 per site) were collected and exposed in lab conditions during 24h to Hg or Pb levels above the median lethal concentrations reported for amphibians (1.5 and 10.5 mg/l, respectively). The parameters monitored above plus mortality were monitored at the end of the assay. Field-collected tadpoles from Pb and Hg polluted sites had higher metal body burden than those from reference sites (median per site as d.w. 540.4-708.1 vs 2.6-9.5 ng Pb/g, 768.2-3103.5 vs 0.1 ng Hg/g; all p < 0.01). Levels of MT (median, µg/g tissue) were significantly higher in tadpoles from Hg polluted sites than in the rest of locations (248.5-307.7 vs. 63.9-136.6; p < 0.01), suggesting that MT can be induced in natural populations, by the sum of environmental factors. Exposure to Hg caused mortality of all individuals, while Pb did not result lethal to tadpoles. Laboratory exposure revealed that experimental treatment rather than pollution at the origin site determined Pb body burden (controls: from reference site 96.7-120.4 ng/g, from Pb site 118-491.6 ng/g, Pb-exposed: from reference site 36979.9-54760.4 ng/g from Pb site: 9043.5-78452.4 ng/g), showing that Pb was readily bioavailable for exposed tadpoles. Lab exposure to Pb increased MT levels in tadpoles from reference sites (exposed vs. non-exposed: 116.3 vs. 41.70 µg/g; p < 0.01), but not in those from Pb-polluted areas. Oxidative stress biomarkers did not differ either between origin sites or because of experimental exposure to Pb. MT levels in tadpoles from reference populations that were taken to the laboratory and kept under controlled conditions were lower (65.6 ng/g) than in control tadpoles from the laboratory (105.99-138.66; χ2 29.29-41.70 µg/g; p < 0.05). This could be a consequence of a reduction in the laboratory of stress sources other than metals that can also induce MT synthesis (e.g. thermal stress). The fact that this decrease was not observed in tadpoles from Pb-polluted sites (105.61-109.41 vs 193.50-130.23 µg/g; p < 0.05) would suggest that these animals may have high constitutive MT levels.
MO054
Do historically metal-exposed amphibian populations acquire resistance to lethal levels?
F. P. Morão, S.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria; I. Vieira, A. Paixão, University of Coimbra / Institute of Food, Science and Technology; J.C. Cucurull, University of Coimbra / Institute of Food, Science and Technology; J.C. Cucurull, University of Coimbra / Institute of Food, Science and Technology; Pina, IDAEA-ATM
The cu

- dioxin-like compounds (DLCs) and embryo transactivation assay to in vivo embryo sensitivities for an amphibian, the African clawed frog (Xenopus laevis)
- pentachlorobiphenyl (PCB 126), or 2,3,7,8-trichlorodibenzo-p-dioxin (TCDD).

Further, in vitro AHR transactivation assays were used to determine sensitivity to activation of the AHR1 isoform of African clawed frog and common snapping turtle to these selected DLCs. It is anticipated that this research will result in a single qAOP linking in vitro activation of the AHR to embryo-mortality with taxonomic applicability across phylogenetically diverse oviparous vertebrates, including birds, reptiles, amphibians, and fishes. This qAOP could guide more objective ecological risk assessments of DLCs to diverse taxa which are not easily studied, such as native species of reptiles and amphibians.
eggs and its success. Results showed significant correlations between expression of some genes and metal contaminant levels, pinpointing some candidate genes to be used as biomarkers of interest for biomonitoring campaigns, which worrying function highlights the need for a close follow-up of these organisms. This study represents the first attempt to address pollutant levels and the biological impairments of such stressors in these turtle species nesting in S. Tomé which, given their classification as endangered species (IUCN red list), is of paramount importance to contribute for conservation measures and management.

MO056 Ecotoxicology of Africa’s three largest reptiles: POPs, metals, eggs, and eggshells

H. Bossuyt, North-West University / Unit for Environmental Science and Management; R. Nel, Nelson Mandela Metropolitan University / Department of Zoology; H. Kylin, Linköping University / Department of Thematic Studies Environmental Change; D. Govender, SANParks; M. Du Preez, North West University / Zoology

The Nile Crocodile (Crocodylus niloticus), Loggerhead Turtle (Caretta caretta) and Leatherbacked Turtle (Dermochelys coriacea) are the largest reptiles in Africa. The bioaccumulation and effects of metals and metalloids on large-bodied reptiles are less well known compared with birds and mammals, especially those from Sub-Saharan Africa. Globally, reptiles are experiencing declines, and pollution is one of the hypothesized reasons for the decline. The Nile Crocodile and Loggerhead Turtle are at relatively high trophic levels, with the Nile Crocodile also being the largest predator in Africa. We sampled eggs from these three species (27 crocodile, and 10 each from the two turtle species) and analysed the shells and contents separately for metallic elements using ICP-MS. Trophic level, body size, and migratory patterns influenced the concentrations in shells and egg contents, but crocodiles generally seem to have lower concentrations than the sea turtles. Compared with data from elsewhere, sea turtle eggs had lower concentrations, but crocodile eggs had higher copper and mercury concentrations. Comparisons between eggshells and egg content elemental compositions for each species clearly showed that eggshells can not be used as proxy for egg contents. Sampling therefore, requires the collection and analyses of unhatched eggs. Relative elemental composition patterns indicated overlaps for the respective egg contents and eggshells of the sea turtles, but not for the crocodiles. We found thicker eggshells significantly associated with higher iron concentrations in the crocodiles. The implications may be that hatchlings may spend more energy to break through the leathery shells, and may therefore affect reproduction. Copper had concentrations that raised concern in all three species. The strontium concentration in the eggshells of the Leatherback Turtle was high. Mercury, copper, and lead concentrations can be monitored as bioindicators in reptiles and can also be analysed for other co-occurring pollutants, such as POPs and endocrine disrupting compounds, since sub-lethal effects, especially when the eggs are covered, is difficult to discern. Based on the work presented here and those of others, it is obvious that more studies are needed to obtain a better picture of the chemical and biological interactions involved with Africa’s three largest reptiles in.

MO057 Improving knowledge flow: from consumer to environmental risk assessment

L. Villamar Bouza, s. barmaz, R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Atiyaephra, EFSA - European Food Safety Authority / Pesticides

The assessment of pesticide residues levels in environmental matrices is part of the risk assessment for non-target organisms under Regulation (EC) no 1107/2009. In the case of risk assessments for birds and mammals, according to EFSA (2009), the Tier 1 assessment uses default values for residues levels (in terms of residue per unit dose, RUD) and residue decline (in terms of a time weighted average factor, TWA). When the Tier 1 risk assessment indicates a high risk a higher tier assessment is required. One option is to refine the estimate for the level of residues that wildlife consume through their diet by calculating specific RUDs or by deriving substance/crop specific DT50 values which are then used to recalculate the TWA factor used in the risk assessment. Often the residues studied under the conventional consumer risk assessment are not sufficient to derive such DT50 values. These are then further evaluated with specific kinetic tools (FOCUS kinetics). It should be noted that the refinement of the RUD values is done only in rare cases since the database at the basis of the default values is relatively large. These refinements allow for a more realistic risk assessment accounting for the differences in residues decline due to the crop type, growth stage, climatic conditions across EU zones and to specific characteristics of the substance under assessment. Other parts of the data used for the consumer risk assessment for pesticides can also provide information for the environmental risk assessment. In particular, metabolism studies in plants are used for the identification of the pertinent metabolites to be further considered in the risk assessment of birds and mammals. The metabolism data for hen and raitoat can also be used for addressing such metabolites. The main scope of this work is to further analyse the standard dataset available and the specific guidance in use for the consumer risk assessment in order to better define how the data and knowledge developed in the context of the consumer risk assessments (internationally agreed methodologies, existing guidance documents) could be integrated in the environmental risk assessment. Particular consideration is given to the possibility of extrapolation between crops, use patterns (e.g. growth stages, application number) and European zones.

MO058 Increasing salinisation effects on Pelophylax perezi populations - Could historical exposure data help?

S. Costa, Universidade de Aveiro / Department of Biology / CESAM, 3810-193 Aveiro, I. Lopes, University of Aveiro / Department of Biology / CESAM, 3810-193 Aveiro

Coastal wetlands are a priority for conservation because they are biodiversity hotspots and have high ecological importance in ecosystem services. However, they are increasingly exposed to strong anthropogenic pressure and climate extremes. Additionally, Intergovernmental Panel on Climate Change (IPCC) reported alarming projections for sea levels rise in the AR5 at 2013. Within this scenario, it is foreseen the salinisation of low-lying coastal freshwater ecosystems due to the intrusion of seawater, which will adversely affect many populations of amphibians. Pelophylax perezi is distributed along all coastal territory in Portugal, where there are some populations located extremely close to coastal limits of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of P. perezi originated from reference and salinized natural populations. Embryos (Gosner stage b8-b10) were exposed for 96h, and in what concerns to the input of pollutants in several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). The following endpoints were monitored: time until hatching, growth and feeding. Comparing the results for time to hatch between salinization-impacted and non-impacted populations, differences were not found. For this endpoint, NaCl revealed to be more toxic than seawater (EC50 of 14.04 and EC50=11.89 mCm for seawater and NaCl, respectively). As well, for the sub-lethally-impacted endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater salinity.

MO059 Wildfires effects on aquatic invertebrates organisms with in situ bioassays

N. Abrantes, University of Aveiro / CESAM/DAO; A. Ré, University of Aveiro / Department of Biology and CESAM; I. Campos, University of Aveiro / Department of Environment and CESAM; J. Pereira, University of Aveiro / Department of Environment and CESAM; J.J. Keizer, University of Aveiro / Department of Environment and Planning CESAM; F. Gonçalves, University of Aveiro / Department of Biology and CESAM

In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attention, particularly in what concerns to the input of polycyclic aromatic hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Águeda, central Portugal) and occurred after the first severe wildfire events in the mentioned area in 2017. In the present study, we evaluated the impacts of seawater and NaCl (tadpole growth, weight and feeding) on the tolerant amphibian species Pelophylax perezi, which worrying function highlights the need for a close follow up of these sites. Results showed significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater salinity.

MO060 Estrogenic effects of an Organophosphorous Flame Retardant (TCP) on Edible Sea Urchin "Paracentrotus lividus"

P.C. López, University of Vigo / Ecology and Animal Biology; E. Pereira-Pinto, University of Basque Country; L. Mantilla-Aldana, University of Vigo / Ecology and Animal Biology; r. beiras, University of Vigo / Toralla marine sciences station (ecimat)

Wildfires effects on aquatic invertebrates organisms with in situ bioassays

N. Abrantes, University of Aveiro / CESAM/DAO; A. Ré, University of Aveiro / Department of Biology and CESAM; I. Campos, University of Aveiro / Department of Environment and CESAM; J. Pereira, University of Aveiro / Department of Environment and CESAM; J.J. Keizer, University of Aveiro / Department of Environment and Planning CESAM; F. Gonçalves, University of Aveiro / Department of Biology and CESAM

In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attention, particularly in what concerns to the input of polycyclic aromatic hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Águeda, central Portugal) and occurred after the first severe wildfire events in the mentioned area in 2017. In the present study, we evaluated the impacts of seawater and NaCl (tadpole growth, weight and feeding) on the tolerant amphibian species Pelophylax perezi, which worrying function highlights the need for a close follow up of these sites. Results showed significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater salinity.
Abstracts
New synthetic chemical compounds, like Organophosphorous Flame Retardants (OPFRs), are widely used by the industry as plastic additives in common life objects, or overlaying woods, fabrics, etc. They pose environmental risk due to their effects as androgenic or estrogenic endocrine disruptors, imitating male or female hormones respectively, interfering in vital functions of the organisms. Increasing presence of those chemicals in the water due to the incomplete elimination in the wastewater treatment plants, is emerging as a new problem in water contamination. OPFRs, like Tris (2-Chloro-1-Methylphosphoryl) Phosphate (TCPP), are a typical flame retardant in plastics, being the most detected chemical in the aquatic system. Possible toxic effect of this chemical has not been deeply evaluated yet. This study aims to explore the possible effect of TCPP as an endocrine disruptor on the edible sea urchin Paracentrocnenus lividus. 392 individuals have been used, and as normal DNA damage, Behavioral Responses have also examined. TCPP exposure did not cause histological damages in the gonads, and the bioaccumulation in the tissues was moderate (mean BCF=28 L/Kg WW). However, the results of the GI in this study, support the idea of an endocrine disruption action of TCPP in females exposed to the compound, thus the compound could be cataloged as estrogenic for this marine biological model. Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

MO061
Short-term effects of fluoxetine exposure on biomarker and behavioural responses of an estuarine fish
J.A. Duarte, M.P. Pais, P. Reis Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V.F. Fonseca, MARE Marine and Environmental Sciences Centre Pharmaceutical compounds are routinely discharged into the aquatic environment. There is growing concern whether they elicit deleterious effects on aquatic organisms, following point source acute exposure as well as chronic exposure. Acute and chronic exposures to fluoxetine (Fluoxetine) and caffeine (Caffeine) are frequently detected in both freshwater and coastal systems and have deleterious biological effects at very low concentrations. Nonetheless, contradicting evidence has been reported with lack of consistency in responses across studies. In this context, short-term effects of fluoxetine exposure were analysed in common goby Pomatoschistus microps, an estuarine resident species. Two experiments were conducted: where 1) fish were exposed to environmental concentrations of fluoxetine for 96h (0.1-100 pg/g l.w) and 2) fish were exposed to high fluoxetine concentrations for 1h (1, 5 and 10 pg/g l.w). Acute toxicity was assessed via multiple biomarker responses, namely antioxidant enzymes activity, dehydrogenases activity, neurotoxicity and biomarkers of deleterious effects (e.g. catalase, glutathione S-transferase, acetylcholinesterase, lipid peroxidation). Behavioural responses also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

MO062
Assessment of PCDD/Fs, dioxin-like PCBs and PBDEs in Mediterranean striped dolphins
F. Capanni, University of Trieste / Department of Life Sciences; J. Muñoz-Arnanz, IQOQ-CSIC / Department of Instrumental Analysis and Environmental Chemistry; L. Marsili, M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; B. Jimenez, IQOQ-CSIC / Department of Instrumental Analysis and Environmental Chemistry; C. Iuliani, University of Siena / Department of Physical Sciences, Earth and Environmental Chemistry

Marine mammals are exposed to a variety of persistent organic pollutants (POPs) that bioaccumulate in marine ecosystems. In the present study, blubber samples from ten stranded Mediterranean striped dolphins (Stenella coeruleoalba) were used to investigate levels of polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs), dioxin-like polychlorobiphenyls (DL PCBs) and polybrominated diphenyl ethers (PBDEs) using gas chromatograph coupled to a high-resolution mass spectrometer and by using the isotopic dilution technique. The WHO Toxicity Equivalence (TEQ) approach was applied. Median DL PCB concentration was 1820 ng/g lipid weight (l.w.) (range: 474-20800 ng/g l.w.) and PBDEs 10.6 pg/g l.w. (range: 2100-20800 ng/g l.w.) for PBDEs and 57.8 pg g l.w. for (45.4-83.5 pg/g l.w.) for PCDD/Fs. Our results were in the same order of magnitude that those reported for the same species in the same area by a recent study from other authors save for PCDD/Fs which were found in an order of magnitude lower. Yet, they were generally much higher that those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower than those reported for sperm whales from North-Atlantic. The PCDF congener profile (penta>hexa>tetra>hepta>octa) was relatively similar to those reported for sperm whales from Australia and to those reported in blubber of striped dolphin (Stenella coeruleoalba) from the Mediterranean Sea. In contrast, the PCDD congener profile (hexa>penta>hepta>octa) was quite different from those with a lower contribution of higher chlorinated congeners and a higher contribution of lower chlorinated congeners. Total calculated TEQs ranged from 275 to 987 pg g l.w. and surpassed the threshold of 210 ng/g l.w. in dolphins in the Mediterranean basin and in the Indian Ocean as starting point of immunosuppression in harbour seals. This high level of contamination is not considered to be the cause of death of these animals, but may have contributed to lowering the defense of their immune system.

MO064
Biochemical and molecular responses to organic contaminants in bottlenose dolphins (Tursiops truncatus geoffreyi) from southern Brazil.
B. Righetti, Universidade Federal de Santa Catarina / NEPAQ-CCA; J.J. Mattos, Universidade Federal de Santa Catarina / NEPAQ, Departamento de Aquicultura; M.N. Siebert, Universidade Federal de Santa Catarina / LABCAI Bioquimica; D.D. Lima, Universidade Federal de Santa Catarina / Bioquimica; F.L. Zacchi, Universidade Federal de Santa Catarina / Departamento de Bioquimica; P. Fruet, FURG Universidade Federal do Rio Grande / Museu Oceanografico; F. Daura-Jorge, P.C. Simões-Lopes, Universidade Federal de Santa Catarina / ECDZ; A. Bainy, Universidade Federal de Santa Catarina / Bioquimica; K. Luchmann, Santa Catarina State University / Engenharia de Pesca; D.N. Roque, Universidade Federal de Santa Catarina / CEPEC - Risk assessment: The impact of exposure to persistent organic pollutants (POPs) in cetaceans. Such effects threaten the maintenance of odontocete populations, emphasizing the need for biomarkers that indicate early-on biological responses to POPs. The present work evaluated biomarker response to organic contaminants in bottlenose dolphins subpecies geoffreyi from two estuarine systems of southern Brazil impacted by agricultural and industrial runoffs: Laguna Estuarine System (LES) (n=7) and Patos Lagoon Estuarine System (PLE) (n=10). Antioxidant enzymes and mRNA transcript levels of genes related to xenobiotic detoxification (AhR, ARNT, CYP1A, GST, MT2), antioxidant defense (GST-β, GPX 4, GR) and immune response (IL-1, MHC-II) were analyzed in integument samples obtained through remote biopsy. POPs were measured in the blubber of the same animals. Generalized linear models (GLMs) were used to analyze the response of each biomarker to PCPs, ZDDTs, Mirex, Chlordane (CHL), Hexachlorobenzene (HCB), sampling season (winter or summer) and location (LES and PLE). The best model to describe each biomarker response, with the lowest Akaike Information Criterion (AIC), was chosen using backward selection. GLMs results indicate that...
the transcript levels of all studied genes were higher in winter when compared to summer, potentially due to enhanced metabolism over colder months. mRNA transcript levels of AHR, GR, IL1 and MT2 genes correlated positively with increasing levels of blubber ΣPCBs, supporting the occurrence of biological response to this class of contaminants. GLMs for MT2 indicated that the transcript levels of this gene are higher in dolphins from LES, possibly due to greater metal inputs in this area. GR activity was higher in dolphins with higher tissue levels. Overall results indicated that the skin of bottlenose dolphins is altered due to exposure to ΣPCBs and 2PDBEs, which co-varied with ΣPCBs and Mirex. Absence of influence of other contaminant classes over biomarker response might be due to low contaminant levels in sampled dolphins. This influence might also have been overshadowed by the effects sampling season. Nonetheless, results indicate a sufficiently high exposure to PCPs and Mirex to trigger a biological response in dolphins from these small resident coastal populations, particularly susceptible to the negative effects associated to contaminants.

MO065 Monitoring Eleonora’s falcon conservation status both at its breeding and non-breeding grounds, using biological (stress indices) and environmental data

V. Tsarpali, University of Patras / Department of Biology; C. Barboutis, Hellenic Ornithological Society / Antikythera Bird Observatory; C. Kassara, University of Patras / Department of Biology; M. Papadimitraki, S. Giokas, University of Patras / Biology; S. Dantona, University of Padua / Biologia; L. Ilgner, University of Padua / Biologia. The present study investigated a battery of stress indices in blood and liver of Eleonora’s falcon (Falco eleonorae Gené, 1839), a colonial breeding raptor of the Mediterranean that overwinters in SE Africa, mainly in Madagascar. In particular, cholinesterase (ChE), acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity, as well as cellular abnormalities (MN assay) were measured in blood samples collected from wild individuals, captured on the island of Antikythera (Greece), in May (N = 13) and September 2017 (N = 19). The results derived from the samples that were collected in May are indicative of the habitat quality at the species’ wintering and/or staging areas, while the ones derived from the samples collected in September are indicative of the habitat quality at the species’ breeding grounds. Moreover, in order to investigate the water quality in the breeding area of F. eleonorae, natural water pond samples were collected in September 2017 and further analyzed for the presence of heavy metals. Additionally, heavy metals were measured in liver of an individual found dead near the water ponds. According to the results, total plasma ChE activity ranged between 3.370±0.433 - 11.343±0.829 nmol mU-1 min-1 in May and 1.444±0.079 - 9.314±1.618 nmol mU-1 min-1 in September. AChE activity remained almost constant between the two sampling periods, while BChE in May was significantly higher than September. Total nuclear abnormalities showed almost similar frequencies in both periods, while cytoplasmic abnormalities observed in September were significantly higher than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQS values. All heavy metals were significantly lower in the water samples from the colonies’ breeding area than in the non-breeding area. The water quality data collected in September 2017 are indicative of the habitat quality at Eleonora’s falcon breeding colonies in the Mediterranean, and could serve as a valuable tool for elucidating the quality of its foraging grounds and, hence, the impact of land use on the species’ conservation status.

MO066 Optimising design and analysis of acute effect field studies

R. Dittrich, Tier3 Solutions GmbH / Wildlife Ecology; I.S. Hotopp, Tier3 Solutions GmbH. Vertebrate risk assessments of a plant protection product (PPP) may indicate an acute risk to wild birds and mammals or predict effects on population development. This might be driven by (too) conservative assumptions on the exposure side of the equation for the risk evaluation, due to the lack of better data. It is therefore worthwhile to study deeply the presence of effects in the field in order to obtain a proper risk assessment. We highlight three complementary ways to improve the quality of such field data. An early study design considering the ‘extensive’ approach, by using a great area or number of agricultural fields in different study sites, with the ‘intensive’ approach, by using radio-tracking techniques in a control/treatment design. This double approach covers the natural variation in parameter estimates and enables the identification of possible treatment effects. The risk-tracking technique is sensitive enough to monitor the fate of individuals in a treated field over a long period of time, and to follow feeding and mortality. However, in most cases the critical point is the disappearance of individuals; an increase in their number can indicate a greater vulnerability to other stressors. In the context of a good study design, we also propose an improved statistical evaluation to increase the detectability of effects in comparison to earlier studies. The Kaplan-Meier survival curve and the Cox proportional hazards model are recommended as methods for the analysis of survival information. The Cox model is a well-known statistical technique used in medical tests. It provides an estimate of the treatment effect on survival adjusted for other explanatory variables. Moreover, as it isolates the effects of treatment from the effects of other covariates, the assessment of results of such field studies is facilitated. Additionally, an essential part of every statistical evaluation is to know the minimum number of individuals needed in order to perceive actual treatment effects in the statistical output. Using data from general radio telemetry studies on real untreated populations of wood mouse and several bird species, we run simulations of acute effects for different scenarios. The results show that minimum sample size is highly dependent on, first, the species, and second, the action mode and persistence of residues of each specific PPP.

MO067 Assessing impacts of legacy pollutants on wildlife of the Trinity River (Texas, USA) using Neotropical Cormorants as indicator species

M.A. Miguel, Texas A&M University / Wildlife and Fisheries Sciences; C. Sandoval, Texas A&M University / Wildlife and Fisheries Sciences; S. Reasor, Trinity River Authority / Trinity River Authority; J.E. Elliott, Environment Canada / Wildlife and Fisheries Sciences. The Trinity River (Texas, USA) has been historically known as a polluted river because of its proximity to the Dallas-Fort Worth area and also because of known discharges of sewage and agricultural irrigation waters to the river. Surprisingly, there are no studies regarding the presence of legacy contaminants in the river and their impacts to wildlife. The objectives of this study were to determine accumulation and potential impacts of persistent organic pollutants such as organochlorine pesticides, PCBS, and PBDEs on nesting aquatic birds of the Trinity River, using Neotropical cormorants (Phalacrocorax brasiliensis) as indicator species. Adult and first year cormorants were collected from two sites on the Trinity River Watershed during 2014 and 2015. Tissue sections from liver, spleen, kidneys, and gonads, were used for histopathology analysis, and a portion of the liver was assayed for OC pesticides. PBDEs and Mn were measured in liver of individual cormorants that overwinters in SE Africa, mainly in Madagascar. In particular, Eimeria sp. was also detected in the kidneys of several cormorants. Our results suggest that aquatic birds using the Trinity River watershed could be at risk for adverse effects due to OC pesticides, PCBs, PBDEs, and Hg. These results should be useful to wildlife managers regarding concerns over contaminant impacts of the Trinity River on wildlife.

MO068 Testing the effects of a neonicotinoid insecticide on songbird migration

M.L. Eng, University of Saskatchewan / Toxicology; B. Stutchbury, York University; C.A. Morrissey, University of Saskatchewan / Biology. Recent decades have seen a dramatic increase in the application of neonicotinoid insecticides, which are now the most widely used class of insecticides in the world. Migratory seed-eating birds that use agricultural landscapes for refueling may be particularly vulnerable to the toxic effects of neonicotinoids. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to environmentally relevant levels of imidacloprid experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northward orientation. To corroborate results from captive trials on free living birds, we conducted a study on radiotagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed to imidacloprid via gavage to a dose that was environmentally relevant (either 1.2 mg/kg bw or 3.9 mg/kg bw (n = 12 birds/treatment). Birds were held for approximately 6 hours, and their body mass and food intake were monitored. Individuals were then tagged with uniquely coded transmitters and released into a MOTUS array of automated telemetry towers in Southern Ontario, Canada to track their movements on a landscape scale. We found that high dose birds significantly reduced food consumption, and imidacloprid exposed groups lost a significant amount of body mass relative to controls within 6 hours of dosing. Using automated telemetry data, we found that birds with the longest stopover durations were in the imidacloprid treated groups. Further analysis of the telemetry data is being used to determine effects on speed of travel and direction of migratory movements across a large water barrier.

M0069 A synthesis of the interactions between anticoagulant rodenticides and wildlife

R. Shore, Centre for Ecology & Hydrology (NERC); N. van den Brink, Wageningen University / Dept of Toxicology; J.E. Elliott, Environment Canada / Toxicology; N. van den Brink, Wageningen University / Dept of Toxicology; N. van den Brink, Wageningen University / Dept of Toxicology. Anticoagulant rodenticides (ARs) are the mainstay of rodent control throughout the world. Regulatory risk assessments indicate ARs pose a significant risk to non-target wildlife but AR use remains widely authorised because the benefits (particularly to human health) are deemed to outweigh the environmental risks. Recently, an authoritative reference text, prepared by 24 international scientists, reviewed the main issues related to ARs and wildlife, specifically: AR use, regulation, exposure pathways, toxicity, mechanism of action, pathology, pharmacokinetics, genetic resistance, non-target risk and its mitigation, alternatives
to ARs and integrated pest management (IPM). Broad concepts that emerged were: there is high conservation of the blood clotting process and so ARs can affect a wide range of non-target species; development of genetic resistance in target species led to global use of the more acutely toxic and persistent second-generation ARs (SGARs); vitamin K1 can be an effective antidote (unlike for many rodenticides); variation in non-target sensitivity may be due to pharmacokinetic, ecological and behavioural processes; >50% of predatory species contain AR residues; AR residues in red kites are exposed to SGARs; knowledge of these kites. SGARs were assessed to be a contributory cause of death in the bird of two SGARs (bromadiolone and difenacoum); brodifacoum; most also contained bromadiolone. Difethialone was members of the public, sent to an investigating laboratory, necropsied and analysed. Investigation of SGAR exposure in red kites found dead in 2015. Carcasses were typically found by data sources and a resultant national WILDCOMS network (www.wildcoms.org.uk/) has facilitated collation of these dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites requires additional evidence (e.g., clinical signs, haemorrhagic lesions); probability of death in relation to AR residues may help assess extent of mortality in populations; tissue residues are informative of exposure but dietary AR concentrations are more suited to assess risk; and primary AR exposure associated with the use of ARs by farmers or the government; AR exposure of non-target population declines, but there is no clear evidence for secondary AR exposure causing population declines. Alternatives to ARs (e.g., bromethalin, cholecalciferol, zinc phosphate) also pose a significant risk to non-target wildlife, livestock, companion animals and people. There are a number of key information needs to better understand the environmental risk from ARs. These are: improved understanding of AR exposure by red kites and risk to wildlife populations; knowledge of exposure and effects in invertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

MO070
Anticoagulant rodenticides in red kites (Milvus milvus) in Britain
Second generation anticoagulant rodenticides (SGARs) can be toxic to all mammals and birds. Studies have shown that, in Britain, there is widespread exposure to SGARs in a diverse range of predatory mammals and birds, including red kites (Milvus milvus). This species may be particularly at risk as it scavenges dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites (Milvus milvus) has been hampered by an independent case may cause localized exposure causing population declines, but there is no clear evidence for secondary AR exposure causing population declines. Alternatives to ARs (e.g., bromethalin, cholecalciferol, zinc phosphate) also pose a significant risk to non-target wildlife, livestock, companion animals and people. There are a number of key information needs to better understand the environmental risk from ARs. These are: improved understanding of AR exposure by red kites and risk to wildlife populations; knowledge of exposure and effects in invertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

MO072
Four years of NewRaptor: results from in ovo exposure in model species and field sampling in raptors
N. Brieis, Norwegian University of Science and Technology / Biology; T.M. Ciesielski, Norwegian University of Science and Technology; M.E. Laseth, The Norwegian University of Science and Technology / Biology; B.M. Jansen, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; C. Sonne, Aarhus University / Department of Biosciences; Arctic Research Centre; T. Nygård, T.V. Johnsen, Norwegian Institute for Nature Research NINA; P. Gómez-Ramírez, University of Murcia / Department of Toxicology; A. García-Fernandez, University of Murcia / Sociosanitaries Sciences; J. Martínez, University of Murcia / Ecology and Hydrology; J.O. Busnest, Norwegian Institute for Nature Research NINA; G. Poma, G. Malarvannan, University of Antwerp / Biology; T. Ramírez, University of Murcia / Department of Toxicology; T. Herzke, NILU Norwegian Institute for Air Research; B. Styristhén, University of Copenhagen / Section of Analytical Biosciences Department of Pharmacy; V. Jaspers, Norwegian University of Science and Technology / Biology
The international research project NewRaptor (ID 230465/F20, funded by the Norwegian Research Council and the Norwegian University of Science and Technology) aims to investigate the exposure and effects of emerging chemicals in birds of prey. The project河道 under investigation include the terrestrial Northern goshawk (NG - Accipiter gentilis) and the marine White-tailed eagle (WTE - haliaetus albicilla) from Norway and NG from Spain. During the breeding seasons of 2015 and 2016, blood and body feathers were obtained from the chicks (WTE n=160 for NG n=160) and field samples were taken in Spain when they were circa 4-9 weeks old. The samples were analysed for novel brominated flame retardants (nBFRs), organophosphate flame retardants (PFRs) and per- and polyfluoroalkyl substances (PFASs), along with trace elements and legacy persistent organic pollutants (POPs). Significant differences were found between the two species (with WTE generally showing higher levels of pollutants), but also within species, depending on the location. PFASs were generally found at the highest concentrations, with perfluorooctane sulfonate (PFOS) being the most important compound. nBFRs and PFRs were found at very low or non-detectable levels in blood plasma. Further, pollutant effects on different biochemical, immunological and endocrine parameters were assessed. We have performed controlled experiments in Japanese quail (Coturnix japonica) and the barn swallow (hansalia domestica) as model species, both with single compounds and in a mixture scenario. The compounds for the quail exposure study included Dechlorane Plus (DP), tris(1,3-dichloro-2-propyl) phosphate (TDCIPP) and their 1:1 mixture and PFOS, F-53B (PFOS replacement product) and their 1:1 mixture were used in chickens. Effects on gene expression and activity of anti-oxidative enzymes (catalase, superoxide dismutase, glutathione-S-transferase and glutathione peroxidase), lipid - and protein oxidative damage and biotransformation (cytochrome P450A1) were investigated. Further, hormonal analysis of corticosterone and progesterone was performed using HPLC-MS/MS. Gene expression and enzyme assays on similar endpoints will be performed on NG samples in January 2018 and will be presented alongside the results from the in ovo exposure studies at SETAC. This will enable discussing the potential usefulness and pitfalls when extrapolating from laboratory dosing studies using model species to field assessments in raptors.
The potential of feathers as a biomonitoring tool for fluoxetine in wild birds
S.E. Whitlock, Environment Department, University of York / Environment; K. Arnold, University of York / Environment; J. Lane, Animal and Plant Health Agency; M.G. Pereira, Centre for Ecology & Hydrology; Lancaster; R. Shore, Centre for Ecology & Hydrology (NERC).

The antidepressant fluoxetine has been identified as a contaminant which may pose a risk to wild birds. However there is little empirical evidence regarding which bird species are most at risk of exposure to fluoxetine, in terms of concentration levels in wild bird samples. A significant barrier to sampling wild birds is that fluoxetine is cleared very quickly from systemic circulation and plasma concentrations might be expected to fall to levels below the limit of detection in less than one hour post-exposure. Fecal sampling presents a similar problem. However, fluoxetine is detectable in the hair of humans and other mammals. We hypothesised that fluoxetine might likewise be detectable in feathers. Moult occurs over a period ranging from weeks to months and during this time, growing feathers have a blood supply. If a wild bird was exposed to fluoxetine during this period, the compound could be laid down in the feathers and subsequently be detectable. We conducted an avian study with wild caught Eurasian starling (Sturnus vulgaris) to determine whether fluoxetine administered during a period of feather regrowth is deposited in the feathers in detectable concentrations. We removed two rectrices (tail feathers) from each bird. We then administered a dose of fluoxetine at an environmentally relevant concentration (3.8 µg d−1) each weekday throughout the regrowth period. We plucked the new feathers once they were fully regrown and analysed them by LC/MS/MS for concentration and developmental, body weight, reproductivity parameters. Our preliminary results indicate that fluoxetine is detectable in the feathers and we will present information on the concentrations present and whether they are correlated with levels in other tissues such as liver and brain. We discuss the extent to which feathers have potential as tools for monitoring the occurrence and severity of exposure to fluoxetine in wild birds.

MO076 Different approaches comparison for evaluation of hypopharyngeal glands (HPG) in honeybees (Apis mellifera L.)

Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in nature as well as in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypopharyngeal glands (HPG) which produce proteinaceous substance to feed larvae and queen. The aim of this study was to validate the different algorithms (including obtaining the material) to conduct the hypopharyngeal glands development evaluation. In order to select the method that combines the highest reliability (the smallest technical error), the optimal cost, the least effort and time-consumption. The study was conducted on honeybees subjected to chronic toxicity studies performed according to the EFSAs guidelines (EFSJSA 2013;11(7):3295). Insects were treated with four different chemicals in 3 to 5 concentrations. The HPG were obtained from 3 bees per test item (in the highest concentration, which did not cause mortality below 50%) and the negative control. Six different approaches for HPG evaluation were tested: - histopathology (HP) of isolated glands (linear and quantitative measurements, imaging); - histopathology (HP) of whole heads (linear and quantitative measurements, imaging); - whole mount (WM) method on isolated gland (linear and quantitative measurements, imaging); - protein absorbance (PA) from isolated glands (quantitative measurements); - protein absorbance (PA) from whole heads (quantitative measurements); - scanning electron microscopy (SEM) (linear and quantitative measurements, imaging). The linear measurements (small and big axis of symmetry) were taken from ten acini from left and right HPG, however for SEM only left HPG were included. The quantitative measurements (number of acini per 1 mm²) were taken during HP, WM and SEM testing. The quantitative measurements of protein absorbance from isolated glands were taken from left and right HPG and analyses of the results showed decreases and increases of acini and protein absorbance depending on the test item. However, observed deviations did not show any statistical significance. According to the performed studies for evaluation of hypopharyngeal glands development the linear measurement combined with imaging should be used.

MO077 Bird and mammal focal species for pesticide risk assessment in rice
M. Vollon, C. Dietzen, S. Laucht, F. Sotti, J. Ludwigs, Rifcon GmbH

Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through exposure to contaminated diet items. To ensure a realistic and reliable risk assessment, bird and mammal focal species should be used that are representative for the species actually occurring in the crop of concern. However, in the relevant guidance document on bird and mammal risk assessment by the European Food Safety Authority (EFSA), rice is to date pooled with other cereals such as wheat and barley, despite the obvious peculiarity of rice cultivation. The generic focal species tested for rice are thus those known from the dry environments of cereal fields. To address this issue, we conducted a comprehensive literature review on bird and mammal species regularly occurring in rice paddies at the relevant time periods of potential pesticide exposure to identify appropriate focal species candidates for risk assessment. Our results show that the relevant species occurring in the wet environments of rice paddies indeed clearly differ from the focal species suggested for risk assessment for wildlife in cereals and thus provide a baseline for more realistic and rice-specific risk assessments for birds and mammals.
Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

R. Mathe, IREC-CSIC - UCLM / Grupo de Toxicología de Fauna Silvestre; L. Giménez-Lozano, IREC Instituto de Investigación en Recursos Cinegéticos; L. Monclus, UAB; I. Chamypp, ASTERS; M. Lopez-Bejar, UAB

A reintroduction project of bearded vulture or lammergeier (Gypaetus barbatus) has been carried out in the Alps since 1987. There are several factors that can affect the success of this reintroduction and one of these is the exposure to lead, which is the main cause of mortality and one of the main reasons for the reintroduction failure. Some programs have introduced biological markers for lead exposure and other contaminants in the diet. However, the interpretation of these markers is controversial, as some experimental studies have been shown to have low specificity and sensitivity. Another important aspect is the age and sex of the animals, as they have different exposure patterns and different lead elimination rates.

MO079 Post mortem stability of phase I and II biotransformation enzymes in the liver of kelp gull Larus dominicanus

J.J. Mattos, Universidade Federal de Santa Catarina / NEPAQ, Departamento de Agricultura; D.D. Lima, Universidade Federal de Santa Catarina / Biosismica; B. Righetti, Universidade Federal de Santa Catarina / NEPAQ-CCA; L.O. Villas Boas, V.H. Dias, Universidade Federal de Santa Catarina / CCB; S. Costa-Silva, C. Kolesnikov, M. Antonelli, Associação R3 Animal; K. Luchmann, Santa Catarina State University / Engenharia de Pesca; A. Bainy, Universidade Federal de Santa Catarina / Biosimica

The measurement of biomarker responses to chemical contaminants in wild organisms represents a powerful tool in environmental monitoring programs. However, getting biological samples suitable for biomarker analysis may be challenging, since some programs rely on samples collected from carcasses. Shorter periods from death to analysis of biochemical biomarkers provides more accurate results.

MO080 Investigating thyroid disrupting effects of organohalogenated contaminants in White-tailed eagle nestlings

M. van der Bracht, The Norwegian University of Science and Technology / Biology; G.S. Eggel, N. Brels, Norwegian University of Science and Technology / Biology; T. Nygård, T.V. Johnsen, J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; C.S. Eggen, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; G. Lepoint, University Meppen / Department of Oceanology; J.M. Pérez-García, University of Leida / Department of Animal Sciences; T.V. Johnsen, Norwegian Institute for Nature Research NINA; A. García-Fernandez, University of Murcia / Sociosanitary Sciences; V. Jaspers, Norwegian University of Science & Technology / Biology

The interpretation of thyroid biomarkers is important for birds’ thermoregulation, metabolism, growth and development.

MO081 Assessment of exposure and effects of Hg levels in feathers of White-tailed eagles Haliaeetus albicilla and Northern goshawks Accipiter gentilis nestlings from Norway

P. Gómez-Ramírez, University of Murcia / Department of Toxicology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; C.S. Eggen, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; G. Lepoint, University Meppen / Department of Oceanology; J.M. Pérez-García, University of Leida / Department of Animal Sciences; T.V. Johnsen, Norwegian Institute for Nature Research NINA; A. García-Fernandez, University of Murcia / Sociosanitary Sciences; V. Jaspers, Norwegian University of Science & Technology / Biology

Anthropogenic activities have led to a global increase of Mercury (Hg) in the environment. Due to its toxicity, legislative measures have been taken to reduce the levels. To assess the effectiveness of such restrictions and the current levels of these chemicals in the environment, biomonitoring using birds is very useful. Hg has caused detrimental effects in birds such as haematotoxicity, immunotoxicity and endocrine disruption e.g. suppression of baseline corticosterone. The aim of this study was to assess the exposure to Hg and its effects at the biochemical/physiological level. The analyzed parameters included total, free and inorganic mercury levels, as well as the levels of other contaminants such as PCBs and organochlorinated pesticides.
**MO083**

**Bioaccumulation of metals in bats: non-lethal vs lethal sampling to assess risk**

J. Alves, R. Miná, A. Alves da Silva, C. Prê - Centre for Functional Ecology, / Department of Life Sciences, University of Coimbra; T. Natal da Landa, University of Coimbra; and M.T. Caldas, Laboratory of Applied Ecology, University of Coimbra. P. Barros, CITAB - Centre for Research and Technology of Agro-Environment and Biological Sciences / Laboratory of Applied Ecology, University of Trás-os-Montes e Alto Douro; C.J. Topping, Aarhus University / Department of Bioscience; J. Sousa, University of Coimbra / Department of Life Sciences

More than 22% of bat species are threatened according to the World Conservation Union. Among the reasons responsible for this decline are the environmental changes due to anthropogenic factors, namely habitat loss through agriculture, forestry, urbanization and industrialization, contamination by pesticides and metals, changes in water quality. There is a growing concern about the possible consequences of environmental contamination in several bat species. Until now, most of the studies on the effects of contaminants on bats are focused on the use of lethal samples: wing scale, to investigate the potential risk of metal contamination in bat species occurring in Portugal, and to evaluate the suitability of non-lethal sampling methods. The concentration of As, Cd, Co, Cr, Cu, Mn, Ni, Pb, and Zn was measured in two categories of biological samples (lethal-samples: liver, heart, bone and brain; and non-lethal samples: wing membrane and fur) collected from bat carcasses of four different species (Hytorcos savi, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus pygmeus).

Concerning the metal concentration obtained in each sampling tissue, significant differences were found between the concentrations obtained in each species for all the metals (Ps < 0.05), except for Zn (Ps > 0.223). Significant differences were also found among different organs, between organs and metals (Ps < 0.001). Depending on the metal, the organ/tissue that showed the highest concentrations varied, but even so far and wing presented the highest concentrations of most of the metals. These results support the hypothesis that non-lethal samples may be useful for studies on wildlife ecotoxicology, and may help to define a protocol capable of being applied at large-scale, to investigate the risk of metal accumulation for bats. For this purpose, non-lethal samples are the best option, and as demonstrated by this study can yield reliable results. Our results therefore provide valuable insights for development of further studies, aiming to understand the importance of metals as a cause for some of the observed declines in bat populations worldwide.

**MO084**

**Metallic element composition of egg contents and eggshells of the Kelp Gull Larus dominicanus**

J.D. van Aswegen, North West University (Potchefstroom Campus) / Unit for Environmental Science and Management; L. Nel, N. Strydom, Nelson Mandela University; H. Birdman, North-West University / Unit for Environmental Science and Management.

The Swartkops River Estuary near Port Elizabeth, South Africa, is an important recreational, industrial, residential, and ecological asset, but under severe pressure. Seabirds are good indicators of trace elements within their environments. Seabirds are long-lived, and many have a wide geographical distribution. The Kelp Gull (Larus dominicanus) were analysed for 30 trace elements, for both the contents and eggshells. We selected five elements (Cr, Sr, Ti, U, Zn) to compare and assess the absolute and relative compositional patterns in egg contents and shells. Mean concentrations for Cr in eggshells and egg contents were 3.8 and 18 mg/kg dm, for Sr it was 880 and 120 mg/kg dm, for Ti it was 0.00017 and 0.00022 mg/kg dm, for U it was 0.00057 and 0.000084 mg/kg dm, and for Zn it was 2.1 and 62 mg/kg dm, respectively. Of the five elements, only Sr (P < 0.00141) and Ti (P = 0.0013) concentrations showed significant positive regressions between egg contents and eggshells. Chromium and Sr showed the highest correlation coefficients, but the regressions were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in bird egg contents is 2 mg/kg dm, indicating concern about this element in the Swartkops River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.

**MO085**

**Heavy metals concentrations in Mediterranean Osprey eggs: variations by location, habitat and egg constituent part**

F. Monti, University of Siena / Department of Physical Sciences, Earth and Environment; A. Sforzi, Maremma Natural History Museum, Grosseto; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Leonzio, University of Siena / Department of Physical Sciences, Earth and Environment

The osprey (Pandion haliaetus) has been historically used world-wide as a sentinel species for the monitoring of selected contaminants for aquatic ecosystems. In spite of this, occasional and fragmentary information are available for the species at the Mediterranean scale, where relict and vulnerable populations exist. In this study, we analyzed heavy metals concentrations in osprey eggs from three different populations of the Mediterranean basin (Corsica, Italy and Balearic Islands). In total, 21 unhatched eggs were collected, over a period spanning from 2005 to 2016. Mercury (Hg), Cadmium (Cd), Chromium (Cr), Copper (Cu) and Nickel (Ni) concentrations in osprey eggs were analysed with the aim to: (1) evaluate geographical patterns of for possible identification of inputs at the regional scale; (2) to evaluate differences in concentrations between samples from different habitats (marine environments and wetlands); and (3) to investigate any differences in concentrations among different parts of the egg (i.e. content, membrane and shell). Samples from the Balearic Islands showed higher Hg concentrations (1.4 ± 1.2 mg/kg dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearics) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher Hg concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first study at regional scale and provides a first set of data for the long-term biomonitoring of heavy metals for the vulnerable osprey populations of the Mediterranean basin

**MO086**

**Interactive effects of vitamin E and BDE-47 yolk supplementation on morphological and oxidative status of yellow-legged gull embryos**

M. Parolini, University of Milano / Department of Environmental Science and Policy; C.D. Possenti, B. De Felice, Università degli Studi di Milano; N. Saino, University of Milano

Oviparous mothers transfer to the eggs components that have both independent and combined effects on offspring phenotype. Functional interactions between egg components, such as antioxidants and contaminants, can play an important role in determining the oxidative status of offspring. To test this hypothesis, we investigated the oxidative status of embryos from three different populations of the Mediterranean basin (Corsica, Italy and Balearic Islands). In total, 21 unhatched eggs were collected over a period spanning from 2005 to 2016. Five elements, only Sr (P = 0.0141) and Ti (P = 0.0013) concentrations showed significant positive regressions between egg contents and eggshells. Chromium and Sr showed the highest correlation coefficients, but the regressions were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in bird egg contents is 2 mg/kg dm, indicating concern about this element in the Swartkops River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.
Sensitivity of freshwater pearl mussel juveniles (Margaritifera margaritifera) to different environmental and contamination factors

T. BELAMY, University of Bordeaux; A. LEGEAY, University of Bordeaux / UMR EPoC CNRS 5805; B. ETCHERRIA, University of Bordeaux / UMR CNRS 5805 EPoC; M. Baudrinmont, Université de Bordeaux / UMR EPoC CNRS 5805

Margaritifera margaritifera is a freshwater bivalve mollusk threatened with extinction in Europe. The population of this freshwater pearl mussel has declined by 90% in Europe, during the XIXth century because of pearl fishing and from the XXth century due to habitat degradation, decrease in water quality and pollution. Nowadays, French population of M. margaritifera is estimated at 100,000 individuals with the largest population found in the river Dronne (Bordogna - FRANCE) with up to 15,000 individuals. Freshwater pearl mussels are considered as an excellent indicator of aquatic ecosystem health since they require high water quality and they filter up to 50 L of water a day. As a result, they are called «umbrella species», meaning that their conservation will benefit all species living in the same river. With the aim of preserving this pearl mussel, the European project LIFE + «Preservation of Margaritifera margaritifera and restoration of river continuity of the Upper Dronne river 2014-2020» has been set up in which a farm was created in order to produce juveniles in captivity. Some of them will be reintroduced into the environment while others will be used for eco-toxicological studies. The aim of this work was to determine the sensitivity of M. margaritifera juveniles to different environmental and contamination factors, since they are considered as the most sensitive stage of this species. Acute toxicity tests were carried out on one-year-old juveniles in order to determine toxicity thresholds (LC50) of several factors such as temperature, dissolved oxygen, nitrates, phosphates and metals. Those data will allow to target reintroduction areas of juveniles produced in the farm and help the conservation strategies of Margaritifera margaritifera in the Upper Dronne river.

Using population modelling to reduce uncertainty - an example of a herbicide

M. Wang WSC Scientific GmbH / Dept Ecatec Modelling; M. Foudoulakis, Dow AgroSciences / RSRA ERS

Uncertainty is perceived as a major acceptability criterion for higher tier risk assessment. While uncertainty does not start to be present at the higher tier (though it is generally not considered in the first tier) it needs to be addressed explicitly when higher tier refinements are applied which make the risk assessment more realistic. The use of standard higher tier refinements or even modelling is sometimes perceived as increasing uncertainty. However, in the present poster we demonstrate that refinements and population modelling help to reduce uncertainty by providing additional insight into the mechanistic understanding of risk and the ecological relevance of effects. This is done based on a risk assessment for a herbicide. It is shown how what-if questions help to address specific questions on uncertainty in the risk assessment and how a margin of safety can be calculated.
freshwater as a resource. In order to clearly define what is to be protected, the freshwater resource is put in perspective through the lens of three safeguard subjects. Considering the current scope of the AoP natural resources, the complex nature of freshwater resources and the dimension of freshwater to safeguard, a definition of freshwater resource is proposed. Also, a wide range of possible impact pathways to freshwater resources is identified, establishing the link between direct and indirect pathways that might affect their potential to cause freshwater depletion or pollution in the long-term. The concept of recovery period is used to operationalize this framework: when the recovery period lasts longer than a given period of time, impacts are considered as being irreversible and fall into the concern of freshwater resources protection (i.e. affecting future generations). The study shows that it seems relevant to include this concept in the impact assessment stage in order to discriminate the long-term from the short-term impacts, as some dynamic fate models already do. Recommendations are also given for freshwater resource impact indicator(s). Therefore, such an indicator would allow LCIA to capture potential long-term impacts that could transparently advise decision makers about potential safe water supply issues in the future.

MO094
Considering water and soil conservation works in Life Cycle Assessment: focus on contour ridges and erosion impacts
M. Jouini, Montpellier SupAgro / Département de génie rural; R. Campiolini, IRD, UMR LISAH; S. Follain, Montpellier SupAgro, UMR LISAH; J. Bunte, CIRAD / UMR GEAN; N. Benaisa, National Agronomic Institute of Tunisia / Science de la production végétale; C. Sinfort, ITAP, Irstea, Montpellier SupAgro, UMR LISAH; S. Gerbinet, Université de Liège / Chemical Engineering; F. Van Stappen, CRAW

The purpose of this study is to compare side-by-side, the Hazard Factors (HF) of ProScaleTM and the Effect Factors (EF) for human toxicity of USEtoxTM, and analyse the results, as both factors have been developed as a metric for adverse human health impacts due to toxic effects. Hazard factors in ProScale are derived based on substances classification in the GHS/CLP classification system, reflecting health effect severity based on the classification of the substance. The GHS/CLP assigns a classification for carcinogenic and non-carcinogenic chemicals separately. Both methods have separate factors for inhalative and oral exposure routes. All the effect factors available in USEtox 2.0 were compared separately. Tendencies of correlation can be identified, but differences are large. Intersecting discrepancies, also of principal matters, have been identified. The results shown are very first results from comparison of ProScale HFs and USEtox EFS for human toxicity. Further work is needed, and under way.

MO095
Impact of heavy metals on human toxicity using LCA: a case study for Wallonia
S. Gerbinet, Université de Liège / Chemical Engineering; F. Van Stappen, CRAW Walloon Agricultural Research Centre; S. Belboom, ULiege; E. Pezennec, Knauf Montpellier / ELSA Research group and ELSA-PACT Industrial Chair

The current study aims at answering the question whether the human toxicity of corn farming in Wallonia, Belgium is of interest for LCA to include. For this purpose, we apply the USEtox model to the corn agricultural system. USEtox is a method to assess human health and eco effects of chemicals on the environment, using Substance-specific Hazard Factors (HF) and Exposure Factors (EF) and it is applied to human toxicity. A detailed database is available for USEtox and for ProScale. The results from comparison of ProScale HFs and USEtox EFs for human toxicity. Correlation can be identified, but differences are large. Interesting discrepancies, also of principal matters, have been identified. The results shown are very first results from comparison of ProScale HFs and USEtox EFS for human toxicity. Further work is needed, and under way.

MO099
Combing use of Mixed-Integer Optimisation and Thermodynamic, Molecular and Charge Density attributes for predicting Life Cycle Production
J. Vrugten, VIT, Swedish Environmental Research Institute; H. Holmquist, Chalmers University of Technology

The purpose of this study is to investigate the potential of the USEtox model to capture human toxicity in LCA. The results in human toxicity, cancer effect, underline the large difference in human toxicity, cancer effect, underlined the large difference in human toxicity, cancer effect, of zinc compared to the base case and mostly related to lead and mercury emissions in the soil. In both cases, the contribution of pesticide is negligible. In conclusion, although the uncertainties about toxicity categories are well-known, this study underlines the impact of the use of pesticides and how a detailed analysis of the results is essential for a critical view on the toxicity results.
Impacts of Chemicals
R. Calvo-Serrano, G. Guíllén Gosalbez, Imperial College London / Chemical Engineering

Process sustainability has become one of the fundamental criteria for decision making in chemical industry, being Life Cycle Assessment (LCA) the most popular method in recent years, currently being one of the most extended sustainability assessment methods. Since LCA is based on the analysis of all interactions for all the stages of the life cycle, it ends requiring large amounts of information. This information, however, can be difficult or impossible to gather, being one of the main obstacles when trying to apply LCA. Chemical industry is particularly affected, easily having thousands of interactions even for small and relatively simple processes and only information of a few hundreds. In these cases, when a full LCA cannot be applied, a simplification version is used instead. These streamlined LCA (SLCA) follow the same basis as LCA, but generally either simplify the scope of the analysis and/or reduce the amount of information required in the assessment.

The precise simplifications to be done (and the assessment discrepancy with the full LCA) have to be specifically considered for the process or activity assessed. Under these principles, we present a novel approach for the estimation of LCA impact categories associated to the production of chemicals using information of their chemical and physical properties. We propose that the physical properties of the products are directly related with the impacts generated in the production process, and that these impacts heavily contribute to the overall impact generated for the production of the chemical analysed. Previous studies demonstrated the prediction capabilities of molecular and thermodynamic attributes. Here we also consider the molecular descriptors, first developed for Research on the environmental fate and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 type-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP 33.55%) or Eco-Indicator99 (EIP9 18.34%).

MO100 Development of USEtox characterisation factors for micropollutants in effluents
E. Maillard, ELSA-PACT Industrial Chair
Many substances are increasingly detected in surface waters, after their use by the human population. In most cases, these substances will exert the same effects as desired when they are originally applied, only now affecting different organisms. These effects can occur at concentrations of μg/l, which is why these substances are called micropollutants. In the context of Life Cycle Assessment, there is a need of characterising the toxicity potential of these micropollutants affecting ecosystems and/or the human population. A substance which is not characterised will not be considered in a LCA study, which may result in misguided decisions and the omission of essential environmental issues related to biodiversity and human health. The aim of this project is to develop a database of characterisation factors for the most micropollutants as attributes, for a better characterisation of the chemicals and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 type-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP 33.55%) or Eco-Indicator99 (EIP9 18.34%).

MO101 Assessment of freshwater eutrophication with USEtox
M. LOT, CEHTA; P. Thomas, CEHTA SAS; F. Sahigara, KREATIS; M. Jacob, TOTAL SA
USEtox is determined as the reference tool for freshwater eutrophicity impact evaluation in LCA context. By the way, it is recommended by several institutes: by European Commission for PEF/OEF project; by JRC-IES in ILCD handbook; by World LCA forum for the chemical and related products; by US EPA in TRACI tool manual. An assessment of the relevance of the Characterisation Factor (CF) with its associated factors was realized. We found that CF appears to be significantly influenced by the effect factor (EF), implying that the 2 others factors, XF (Exposure Factor) and FF (Fate Factor), do not intervene, or very little, in the final calculation of CF. This finding is surprising because the XF and FF factors show influence the calculation of CF as they represent, significant fate and exposure factors. The model of USEtox allows calculating the aquatic biodegradation in the chemical and physical properties of USEtox model. In order to develop this database, the following tasks are needed: identification of a priority list of substances currently missing in USEtox, while being highly relevant in the context of treated and untreated effluents; Literature review and database searches on existing data (required to calculate fate, exposure and effects) for the priority substances identified; Establishment of a database of new characterisation factors for human toxicity and eutrophicity impact potentials. All these newly developed characterisation factors will be submitted for inclusion to the official USEtox database center.

MO102 Advancing nutrient modelling in eutrophication methods for life cycle impact assessment

The precise simplifications to be done (and the assessment discrepancy with the full LCA) have to be specifically considered for the process or activity assessed. Under these principles, we present a novel approach for the estimation of LCA impact categories associated to the production of chemicals using information of their chemical and physical properties. We propose that the physical properties of the products are directly related with the impacts generated in the production process, and that these impacts heavily contribute to the overall impact generated for the production of the chemical analysed. Previous studies demonstrated the prediction capabilities of molecular and thermodynamic attributes. Here we also consider the molecular descriptors, first developed for Research on the environmental fate and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 type-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP 33.55%) or Eco-Indicator99 (EIP9 18.34%).

MO103 Land Use Change comprehensive framework in LCA for microalgae cultivation systems as emerging production option in the bio-economy
L. Companioni, D. Maragga, University of Bologna; S. Righi, University of Bologna / Physics; E. Balugani, E. Merlino, University of Bologna Europe is nowadays facing serious issues about natural resources depletion. Promoting sustainable development, the concept of green economy will enable the transition from a fossil- to a bio-based society. In this context, algae represent an emerging resource of great importance for their potential applications. Specifically, microalgae are currently promoted not only as fuel-sources, which have been studied since decades, but also as high-value products useful in pharmacy, cosmetics, nutraceuticals as well as for aqua- and agricultural uses, hence considered as a promising resource to develop a green economy. The knowledge gaps will allow several LCA's of algae-based products have been performed on a wide range of production processes. A Scopus review on “algae LCA”, indeed, reported 228 total papers published in the scientific literature since 1989, experiencing a fast-growing trend from 2010 onwards, mostly regarding biofuels (>77%). However, one impact category of the algal-based product life cycle that is commonly overlooked, while being of high importance for the bio-economy, regards land use change (LUC), with only 8% of algae’s LCA-related studies including it. Land use influences biodiversity as well as the structure and functions of ecosystems, causing damage to many areas of protection through diverse impact pathways, such as biodiversity...
Damage Potential, Ecosystem Services Damage Potential, Biotic Natural Resource Depletion and Climate Change. However, only few of these impact pathways are fully implemented in currently available LCIA methods, also due to lack of significant consensus on this novel impact category. Specifically, LUC has to be carefully evaluated when assessing microalgae’s cultivation systems, as they may be strongly diverse one each other, hence impacting through diverse paths. Cultivation layouts may range, in fact, from large open ponds to more compact photoreactors; they may be installed in coastal or inland environments, such as fresh water ponds or offshore culture systems, either in brownfield lands in an optic of redevelopment of industrial areas, hence even generating a positive effect to the environment, mostly in terms of GHG’s fluxes and biodiversity. In this respect, the study aims at providing a consistent framework of the current methodology on LUC impact category and its application to bio-economy and, specifically, to microalgae’s production in order to provide support to business and policy decision making.

MO104 Application of LCA water use methods to renewable energy systems in Spain L. Sánchez-De Castro, D. Garrain, Y. Lechón, CIEMAT / Energy Dept Energy Systems Analysis Unit

The topic of ‘water’ in LCA has emerged as an important approach to quantify the related effects of water use from consumption of goods and services. Several assessment methods have been proposed by the scientific community, encompassing both the computation of water use and its impacts, but differing in the way in which each is calculated. After doing a current state-of-the-art of the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: 1) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Re Manning per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint P. Quinteiro, University of Aveiro / Department of Environment and Planning; b. hidoutu, CSIRO; L. Arrojo, A. Dias, University of Aveiro / Department of Environment and Planning

Freshwater stress and its implications for present and human welfare and the natural environment awaked the need to develop spatially explicit methods to calculate the product water footprint (WF) from a life cycle perspective. In this sense two parallel developments emerged: a water footprint assessment (WFA) developed by the Water Footprint Network (WFN) to map direct and indirect water use along supply chains and its relevance in water resources management; and an impact-based WF following the life cycle assessment (LCA) methodology, according to the ISO 14046. Both WFN and LCA-oriented impact assessment methods consider blue water (fresh surface and groundwater) and green water (rainfall on land that does not run off can be used as irrigation, or is used, stored, or temporarily stays on the top of the soil and vegetation). Although these both approaches agree on considering the degradation of water, the WFN defines grey water as the volume of freshwater that is required to assimilate the load of pollutants based on natural background concentrations and existing ambient quality standards, while LCA-oriented impact assessment methods consider the water degradation within the well established LCA impact categories (e.g. eutrophication, acidification). This work addresses the state of development of both WFA and impact LCA-based WF approaches, identifying recent impact LCA-based WF methods, and the following methodological challenges that need to be overcome to establish a consensual and comprehensive impact LCA-based WF method: (1) accounting and assessing the potential environmental impacts of green water flows; (2) inventory of actual blue freshwater consumption in agriculture; (3) temporal and spatial variation to establish explicit characterisation factors (CFs); and (4) adequate connection between inventory flows and spatio-temporal explicit CFs. Robust and reliable methods, and guidelines for assessing and reporting WF results are needed. It is crucial to ensure the applicability of the WF by non-academia, ensuring quality standards as well as reporting for a general public audience as a means of assessing the potential environmental impacts of freshwater stress and raising awareness of a sustainable use of freshwater resources. A distorted communication of the WF results, without understanding the effects of the land-use and land cover change and water irrigation on the WF damage, and without considering spatial differentiation, can represent a danger and pitfall for decision-making.

MO106 Filling the Gap of Overfishing in LCA: Eco-factors for Global Fish Resources M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences; L. Eymann, ETHZ Swiss Federal Institute of Technology; B. Kelle, R. Iten, Zurich University of Applied Sciences / Institute of Natural Resource Sciences

There is a lack of LCIA methods to assess the contribution of fish consumption to the global problem of overfishing. Due to this methodological gap, fish is often determined to have a lower environmental footprint than other sources of animal protein in LCA studies. The aim of this publication is to present the development of eco-factors for fish resources and by-catch as an addition to the Swiss Ecological Scarcity Method 2013 and to compare the eco-factors of different fish resources and the impacts of fishing as well as the impacts of dietary alternatives like chicken, pork, lamb, beef and veal. The sustainable use of fish resources ensures that the fish stock for each fish species exceeds the minimum stock needed for a maximum sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FSMSY) and the current fish stock (FS) for the characterisation of the use of fish resources. The eco-factors were calculated for each fish species and fishing area. The inclusion of the eco-factors shows the relevant contribution to the total environmental impact of fish compared to fishing and fish processing. Depending on the fish species, fish can have significantly higher overall impacts compared to different types of meat. The contribution of the eco-factors for by-catch is minor compared to fish resources but still relevant for the comparison with dietary alternatives. Distance to target based eco-factors using regionalised data for FS and FSMSY not only follow a comparable underlying approach as suggested in literature but also enable aggregation into a single-score with other environmental impacts. The overexploitation of fish resources is highly variable for different fish species and fishing areas as well as for by-catch. When comparing fish to equivalent dietary alternatives like chicken, pork, lamb, beef or veal, consideration of the overexploitation of fish resources results in some fish species exceeding the environmental impact of dietary alternatives. Therefore, the overexploitation of fish resources is relevant in the Life Cycle Assessment of fish products in different diets. The suggested approach can be applied to inventories for each of the three main types of hydropower plants and is able to reflect the regionalised impacts caused by the overexploitation of fish resources.

MO107 Constructing life cycle inventories for the hydroelectric sector in Peru: methodological considerations and environmental impacts I. Vázquez-Rowe, Pontifical Catholic University of Peru / Civil Engineering Environmental Science; D. Verán-Leigh, Pontificia Universidad Catolica del Peru / Civil Engineering Environmental Science

According to recent reports, hydropower currently accounts for 41.6% of worldwide electricity generation. Low carbon emissions are usually related to this source of energy, making it an attractive option for nations with hydropower potential to meet increasing electricity demand without relying on burning fossil fuels. However, the new wave of hydropower plant construction is occurring mainly in three tropical river basins: Amazon, Congo and Mekong; therefore, an additional environmental impact must be considered: biogenic greenhouse gas (GHG) emissions due to the biogenic carbon (BC) emissions due to the degradation of BC in reservoirs. Peru is planning on installing up to 2,000 MW of installed capacity in hydropower until 2021, but the input and output flows, as well as the environmental impacts that these generate have not been explored. In this context, a set of three run-of-river hydropower plants built in the past decade located along the Peruvian Andes were analyzed from a life-cycle perspective. The main objective of the study was to construct a detailed life cycle inventory for each of these three hydropower plants with the aim of having specific information for real conditions in Peru. This information was used to compute the environmental impacts linked to the generation of electricity at the plants. Although the main aim was to determine the GHG emissions linked to this process, considering the important policy implications of decarbonizing the Peruvian electricity grid, other environmental categories, such as eutrophication, acidification, terrestrial damage, etc. were also considered. The results computed show that GHG emissions per kWh of electricity produced were in the lower range of emissions observed in the literature, in all three cases below 3 g CO₂eq per kWh. Biogenic emissions represented less than 5% of the total GHG emissions despite their location in a tropical nation, due to the arid conditions of the landscape in the Highlands, as well as the mild temperatures that are present in the reservoirs. Results intend to be of utility for an array of applications, including relevance in decision-making in the energy sector, policy-making at a national level, considering the implications in terms of meeting the Nationally-Determined Contributions to mitigate climate change in the frame of the Treaty of Paris, and for the international LCA community in an effort to expand the amount of inventories available for different geographical and technological conditions.

MO108 Global scale characterization factors for freshwater eutrophication from nitrogen and phosphorus emissions to water and soil F. Brands, Radboud University; R. Van Zelm, Radboud University Nijmegen / Department of Environmental Science; A. Beusen, PBL; R. Van Zelm, Radboud University / Department of Environmental Science

Eutrophication is a key water quality issue triggered by increasing nitrogen (N) and phosphorus (P) levels and potentially posing risks to freshwater biota. In life cycle impact assessment, spatially explicit characterization factors (CFs) of phosphorus emissions to freshwater causing eutrophication have been derived. However, for nitrogen impacts, no efforts have been undertaken yet. Moreover, neither for agricultural emissions of P nor for N spatially explicit CFs have been derived. Therefore, the goal of this research was to determine spatially explicit CFs for
freshwater eutrophication due to nitrogen as well as phosphorus emissions from wastewater treatment plants (WWTPs) and agriculture on the global scale. CFs were defined as the change in potential net or potential net input to freshwater (via WWTPs) or agricultural soil and consist of a fate and an effect factor. To determine the fate factors, the change in N and P concentrations resulting from agricultural as well as freshwater isopleths for the year 2000 compared to year 1990 were separately modeled for every river basin in the world. Effect factors were based on the log–logistic relationships between the PNOF (dimensionless) of heterotrophic species and total P (TP) or NO3 concentrations. The PNOF – concentration relationships were determined using data on the highest concentration where a species was observed in field studies. Our work provides the opportunity to quantify worldwide spatially explicit net environmental impacts due to nitrogen as well as phosphorus from soil as well as from freshwater emissions, in a coherent way. The factors can be applied to determine eutrophication impacts of products in LCIA, as well as to determine country-specific eutrophication footprints using multi-regional input-output (MROI) analysis.

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors (P)

MO109 Carbon and material footprint of consumption in Flanders - an input-output based assessment
A. Vercalsteren, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten, VMM-MIRA
Environmental footprints of a country or region are a measure for the environmental impact that is caused worldwide by national or regional consumption. The Flemish Environment Agency (VMM) asked VITO to assess the carbon and material footprint of consumption in Flanders (region of Belgium) and identify hot spots and bottlenecks, based on the Flemish environmentally extended input-output model. The Flemish EE-O model is based on specific monetary and environmental data for the Flemish region of Belgium and is part of an interfregional IO-model in which trade with the Brussels and Wallon Region is modelled in IO-tables. Imports from outside Belgium are included via the link with the use table of Exiobase. A monetary consumption matrix for households divides the final demand vector of households in different consumption categories. In 2010 the carbon footprint of Flanders amounted to about 20 tonnes per inhabitant. Nearly three quarters of the carbon footprint are linked to household consumption, mainly caused by the production and transport of the goods and services consumed. Three quarters of the carbon footprint of goods and services purchased by households are linked to housing, food and personal transport. Whilst the majority of the greenhouse gas emissions, primary materials and employment is outsourced, the added value linked to Flemish consumption is mainly created in Flanders. The presentation will introduce the overall results of the carbon and material footprint assessment of Flemish consumption in 2010 and go more in detail into the value chain impact of some household consumption activities e.g. food consumption. The relation between carbon and material footprint, geographical and sectoral distribution of different production chains and consumption activities, and the relation with added value and employment created by Flemish consumption will be discussed. As the model is available for 2003, 2007 and 2010, the evolution over these years will also be presented. Conclusions will mainly focus on methodological issues and policy implications that follow from this analysis. To achieve the greatest possible global environmental benefit, it is not enough to focus on a country or region’s boundaries alone. There is also a need for a policy that is aimed at making production chains and consumer behaviour more sustainable, including internationally harmonised calculation methods and targets of footprints to evaluate the results.

MO110 A cross-country analysis of the relationship between economic structural change and CO2 emissions
K. Shiromita, Kyushu University / Economics; S. Kagawa, Kyushu University; Y. Kondo, Waseda University
In this study, we focus on the effects of changes in material and energy input structure on the life-cycle CO2 emissions (i.e., consumption-based emissions). Previous studies have demonstrated how structural changes including the shift toward a service economy and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an important follow-up research that examines the environmental effects across countries and evaluates whether or not the development levels of countries can explain those environmental effects. Specifically, we employed a multi-regional structural decomposition analysis based on the World Input-Output Database (WIOD) during 1995 to 2008 (Dietzenbacher et al., 2013) and decomposed life-cycle CO2 emissions of 40 nations into the following four inducement sources: (i) inputs from material goods (including energy) to material goods, (ii) inputs from material goods to services, (iii) inputs from services to material goods, and (iv) inputs from service to services. From the results, we found that the role of inputs from material goods to services and inputs from services to material goods in increasing life-cycle CO2 emissions have become more important than inputs from material goods to material goods in not only developed countries but also developing countries. Services are sustained by manufactured goods, so manufactured goods are necessary for the continued growth of service sectors. In a developed country, a large proportion of its GDP is generated by tertiary sector activities, and the role of service sectors in economic growth will expand more and more. In developing countries too, since the proportion of production from primary and secondary industries will shrink and that from tertiary industries will rise with their economic growth, the importance of service sectors will be enlarged. For this reason, it is essential to focus on the production systems of service sectors to reduce domestic CO2 emissions. It is especially important to sift to the industrial structure with less emission-intensive material goods.

MO111 Influence of substance coverage on impacts from the electricity sector
A.S. Leclere, DTU / Management Engineering; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering; R. Wlodariak, Norwegian University of Science and Technology / Biology; A. Laurent, DTU / Division for Quantitative Sustainability Assessment
The electricity sector is a major source of emissions of greenhouse gas, but also heavy metals, dioxins or radioactive isotopes. However, most environmental assessments of the electricity sector at national or global scale focus solely on climate change and do not include other environmental impact categories such as particulate matter formation or toxic impacts on human health. At the national scale, the few available databases are limited to a narrow substance coverage. For example, official reports of pollutants emissions to the European Monitoring and Evaluation Programme (EMEP) should cover 23 substances in 51 countries, but they are not always complete. The Multi-Regional Input-Output database EChangelink includes emissions emitted to air in 44 countries and regions but only for 33 substances. In comparison, the database Ecoinvent provides emission data for hundreds of substances in the unit process inventories for electricity and heat generation. Here, we aim to develop a globally consistent and extensive database of airborne emissions from electricity production to get a more realistic coverage of toxicity impacts in large-scale life cycle assessments (LCAs). We thus built the Ecoinvent-based National Energy-related Emission Inventory (ENEI) by upsampling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory ENEI covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we showed that using ENEI may underestimate the toxicity impacts associated with electricity production by a factor ranging from 1.4 to 1.9, while Ecoinvent may cut them off by up to 4 orders of magnitude in some countries. This demonstrates the importance of having an extensive substance coverage to fully represent the environmental impacts of electricity production.

MO113 Mapping the carbon, air pollution, and biodiversity footprints of nations: A GIS + global supply chains
K. Kameoto, Shinshu University / Faculty of Economics and Law; D. Moran, Norwegian University of Science and Technology
"Spatial footprinting" is an approach for locating the actual hotspots where impacts during the consumption of a good or service occur. As GIS technology offers the potential to link any remote sensing or earth observatory GIS data that is tagged to an economic sector to any multi-regional input-output (MROI) based economic model. We present a new method for locating at a subnational level the environmental emissions induced by global supply chains. As the world economy becomes more complex it is increasingly difficult to connect consumers and other downstream users to the origins of their GHG emissions and other impacts. Given the important role of subnational actors in GHG abatement and other environmental protection efforts, it is advantageous to connect consumers to the locations where their purchases are driving environmental pressure. We present spatial footprint results for 187 countries showing the footprint of GHG emissions, air pollution hotspots, and biodiversity threats, and discuss our spatial footprinting methodology.

MO114 LCA data machine applied
A. Ciroth, GreenDelta; M. Srocka, GreenDelta GmbH
In any LCA study, finding data sets that are “fit for purpose” is probably one of the aspects which consumes most time and effort, and the data sets which are used have obviously a direct implication on the stability of the result achieved. This high effort for finding and creating data sets is true despite the existence of several comprehensive, generic databases for LCA. It is underlined by the presence of intransparent, outdated, or out-of-region and context data set in these databases. For this reason, an “LCA data machine” has been developed at GreenDelta in the last 3 years, and was already presented earlier at conferences. The LCA data machine automatizes creation, update, and to some extent also review of data sets in LCA and sustainability assessment. Data sets are created to meet several specific requirements, e.g. related to region, time, or nomenclature system, but can also be
created so that they meet requirement sets, such as, for example, related to PEF. Meanwhile, the “DAMA” has been applied to various sectors, products, and data sources. The presentation will summarise key steps of the development and will demonstrate the DAMA, for specific data sets and also for specific use cases. The LCA data machine will be demonstrated in three different application cases: 1) finding and if necessary creating data sets in situations where no data set is directly available, i.e. for data gaps; Paper machine example 2) creating a data set as copy of an existing dataset, for adapting specific, local needs; Creating soy bean production for India from soy bean production US 3) Product comparison, identification of differences between compared products The approach with DAMA will also be compared to approaches currently used in LCA, with examples from the PEF remodeling project and others. The LCA data machine has the potential to truly change the current approach for data set creation, exchange, and also use, in LCA and related areas and can be especially useful for creating inventories in a larger scale.

MO115
Static and dynamic modeling of high performance buildings: Comparison of average and marginal electricity mixes, a consequential effect on LCA results
M. Bilec, W. Collinge, University of Pittsburgh / Civil and Environmental Engineering; H. Rickenbacker, University of Pittsburgh / Civil & Environmental Engineering; A. Landsis, Clemson University / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine / School of Population and Public Health

Tiliaant ontwikkelde elektriciteitsstroom (LCA) involves explicit assumptions and major uncertainties associated with the source of electricity across two main dimensions: spatial and temporal. There is a need within the LCA community for an approach that addresses this ambiguity and allocates environmental impacts as a function of marginal and time-specific variations. In our study, particular attention is paid to the dynamic characteristics of two buildings’ electrical energy consumption in relation to the specific power generation sources. Our LCA models depend on hourly energy use data for on-site renewable production at a net-zero energy building (NZEB), and hourly or sub-hourly electrical energy usage data at a LEED Gold building; both are situated in an energy conservation district located in Pittsburgh, PA. Seven iterations of both static and dynamic life cycle assessment (DLCA) based-models were performed and evaluated based on building energy use (predicted vs. observed), electrical grid time resolution (yearly, monthly, hourly), and region-specific electrical grids and data sources (Environmental Protection Agency, Department of Energy). Our results illustrate that the use of photovoltaics at the NZEB produced excess electricity by on-site renewables which is distributed back to the grid and can be interpreted as avoided upstream emissions (generation at the power plant), which in some cases may offset or erase marginal impacts. The marginal consequential model improved the payback period by an order of magnitude (12.5 years to 3.0 years). Additionally, the dynamic scenarios explored in this study were able to effectively account for the growth in natural gas generation, assigning or ignoring emissions based on a marginal increase or decrease load during the building’s energy use. The LEED Gold building is solely reliant on the regional electricity grid, making its findings indicative of a market-as-usual scenario and therefore comparable and/or scalable to other building studies. No studies combining time-resolved building electrical usage with time-resolved grid electricity production have been found in a U.S. context. There are notable differences between the European and North American power grids, on that account this approach aids to the advancement of DLCA research domestically.

MO116
Life cycle framework for environmental assessment of public transport systems
A. Shinde, Indian Institute of Technology Bombay, Mumbai, India; A. Dikshit, Indian Institute of Technology Bombay, Mumbai, India / Centre for Environmental Science and Engineering (CESE); R. Singh, Thinkstep Sustainability Solutions Pvt. Ltd., Mumbai, India

Several studies have assessed life cycle environmental impact of public transport systems. However, there is no single platform, software or tool for comparing the environmental performance of commuting options. The objective of this study was the development of an LCA based framework to evaluate, analyze and compare the life cycle environmental impact of public transport systems. The modular and parameterized system of GaBi 6.5 platform has been used for exploring the life cycle environmental performance of commuting trains, public bus transport and intermediate public transport (IPT) modes viz. taxi, auto-rickshaw. The system boundary comprises the environmental impact of construction, maintenance of transport infrastructure, manufacturing and maintenance of the vehicle, energy/fuel production and tail-pipe emissions. This framework is capable to characterize the per passenger km travelled (PKT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PKT environmental impact of public transport systems are highly sensitive to ridership levels, the environmental impact of public transport systems and IPT modes has been compared for off-peak, average and peak hour levels of ridership. This framework has been developed on the basis of extensive data collected for the material and energy required for the construction and maintenance of infrastructure, manufacturing and maintenance of rolling stock, use phase impacts of fuel/energy production and tail-pipe emissions, in addition to the transport of raw materials. Therefore, this framework is highly comprehensive but it is also amenable to future additions and expansions. The regional transport authorities can proactively address the target areas for improving the environmental performance of their transportation system, and ultimately the competitiveness of their network. The regulatory authorities will have the information to improve on their policies to reduce environmental impacts associated with each mode at each stage.

MO117
Environmental impact assessment of rail freight intermodality in Belgium using the Life Cycle Assessment methodology
A. L. MERCCHAN, University of Liege / Chemical Engineering, PEPs; S. Groslandemb, University of Liege / Chemical Engineering; A. Léonard, Liège Université / Chemical Engineering - PEPs

BRAIN-TRANS is a project supported by the Belgian Federal Government that deals with the possible development of rail freight transport in Belgium, analysing the current situation of the intermodal freight transport from an interdisciplinary perspective. The objective of increasing the role of the rail freight transport is linked to the European Commission’s White Paper on transport (2011), which aims to shift the 30% of road freight over 300 km to other modes of transport more energy-efficient such as rail or waterborne transport by 2030. In the framework of the BRAIN-TRANS project, the Life Cycle Assessment (LCA) methodology has been chosen to analyse the environmental impact of the intermodal rail freight transport in Belgium. In a first stage we have carried out the LCA of rail freight transport (distinguishing between electric and diesel traction), inland waterways transport and road freight transport independently. In a second stage we have carried out a study of the environmental impacts related to intermodal rail freight transport. For this, we have studied several consolidated intermodal rail-road routes in Belgium. The aim of this analysis is to compare the environmental impacts of these different scenarios and to make recommendations to the EU MoR forum about the optimal choice of the modality that should be chosen to integrate the rail freight development in order to define the sustainability impact of future intermodal transport. They could help in making optimised policy decisions relative to the development of intermodal transport in Belgium, including environmental aspects and allowing the reduction of emissions in the transport sector.

Modelling and monitoring of pesticides fate and exposure in a regulatory context (P)

MO119
Quantifying visual assessment of kinetics - Development of an objective criterion to support visual assessment of SFO fits of parent soil degradation
J. Wilt, Bayer AG / Environmental Safety; S. Beulke, Enviresearch Ltd; S. Ford, JSC International Limited; D. Patterson, Syngenta; B. Erzgraeber, BASF SE; M.A. Thomas, Monsanto Company; I. Hardy, Batelle; R.L. Jones, K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; J.A. Hingston, Chemicals Regulation Division

Kinetic evaluation of soil degradation studies for parent compounds is a key step to derive degradation endpoints. For modelling endpoints, single-first order (SFO) kinetics is preferred when acceptable, because it is implemented in exposure models. In presence of some bi-phasic tendency, acceptability of SFO is a recurrent source of discussions in the regulatory context. FOCUS kinetics guidance proposes Chi2err < 15% and visual assessment as decision criteria. However, the Chi2err measure misleading as it does not account for systematic deviations, whereas visual assessment is inherently subjective. In the framework of a group led by UK CRD, to update FOCUS kinetics guidance, we aimed at finding criteria to quantify visual assessment. We collected 40+ example soil degradation studies that were analyzed separately by 4 experts based on visual assessment, using scores between 0 (clearly SFO) and 10 (clearly bi-phasic). Individual scores showed high variability, exceeding the subjective visual assessment. Based on group discussions, we derived group consensus scores. Consensus scores showed little correlation with Chi2err (R^2 = 0.23). Among several proposed criteria, the SWARC (scaled and weighted area under the residue curve) criterion showed the best correlation to the consensus scores (R^2 = 0.77). SWARC was specifically developed for this task. The residue curve is split into blocks of the same sign (i.e. over- or underestimating the modal residual data). The SWARC is weighted depending on the number of residues and summed up. The result is normalised by the study duration; a scaling factor accounts for high deviations from the last data
point. Thus, the criterion mimicks the visual assessment process, taking into account the presence and size of systematic deviations, and whether the model adequately predicts the last data point, as a measure for extrapolation capacity. We find that SFO fits with SWARC < 40 can be considered clearly acceptable; for higher SWARC values, SFO may still be acceptable (particularly if SWARC < 65), but DFO should also be assessed. Testing of the criterion for metabolite fits showed that in 99% of the cases, it was concluded that model calibration can also be useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MO120 "Southside"- Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe

B. Gottesbaeren, BASF SE / Crop Protection, Environmental Fate Modelling; H. Bayer, BASF SE; K. Plat, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modelling; B. Erzgraeber, BASF SE; F.P. Donaldson, BASF Corporation / APD/EPR; J. Goulet-Fontin, BASF SA; F. Kröger, Eurofins Agroscience Services GmbH

In European regulations degradation rates in soil (DegT50) from terrestrial field dissipation studies TFD studies considered for exposure modeling may originate from "any" sites with soil and climatic conditions similar to Europe. An OECD Ecoregion similarity model (ENASGIS) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. coastal areas were found to be acceptable. The normalized SFO DegT50 can be extended to other regions of the world. An experimental and GIS/modeling feasibility study ("Southside") was initiated to demonstrate if TFD studies conducted in the Southern hemisphere (i.e. New Zealand, Chile) under climatic, soil and cropping conditons similar to conditions in the Northern hemisphere may deliver similar soil degradation rates and DegT50 endpoints than those from Europe. Similar similarity zones were identified between the New Zealand and Chilean sites and EU/NAAFTA using the OECD ENASGIS tool as well as an adapted GIS crosswalk with JRC-EOFS climate and soil maps for EU. The trial sites had soil types ranging from loamy sands, sandy loam, loam and silty loams. In New Zealand the sites were located on the North Island having an average annual air temperature of ~12-13°C and an average cumulative annual rainfall of ~780-970 mm. In Chile the sites were located in the Región del Biobío east of Concepción having an average annual air temperature of ~14°C and an average cumulative annual rainfall of ~800-900 mm. The terrestrial field dissipation (TFD) trials were conducted according to OECD 232 (DegT50 module, soil covered with sand) with different pesticides at 3 sites in New Zealand and in Chile, having no historic use of these pesticides. All pesticides were applied in commercial formulations as a tank mix together in the same spraying on the same field plots at the same time. The field DegT50 were normalised to reference conditions (20°C, moisture p2) during kinetic analysis according to FOCUS, considering local soil conditions and weather data to estimate soil temperature and soil moisture with the PEARL model (as had been done with the EU studies). The quality indicator values of curve fit to data (Chi error) were found to be acceptable. The normalized SFO DegT50 in the "Southside" trials in New Zealand were found to be in the range of those from TFD studies in Europe using the same study design.

MO121 Residues of currently used pesticides in Central Europe arable soils: status quo, reasons and consequences

J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX, P. Kosubova, Central Institute for Supervising and Testing in Agriculture; S. Polakova, Central Institute for Supervising and Testing in Agriculture / Official control section; M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Brodsky, Charles University in Prague; L Biedl, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX, K Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); P. Dinisová, AQUATEST Inc., Z. Simok, L Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); H. Bleda, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Svobodová, L Krkošková, J. Vasicová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); N. Neuwirthová, Masaryk University

Current agricultural management is usually based on high consumption of pesticides which may bring a lot of environmental problems. Alarming results from monitoring pesticide residues in EU groundwater and surface water evoke the question of whether the arable soil can contain significant contamination as a result of the intensive use of pesticides in the present or past. Therefore, in 2014 - 2017, agricultural soil was monitored at more than 100 locations in the Czech Republic for more than 50 representatives of currently used pesticides, their selected transformation products and also banned atrazine and simazine with their transformation products. The results showed that the contamination of the monitored soils with the analysed pesticides is quite extensive. At least one pesticide exceeded the threshold of 0.01 mg/kg. The soils also frequently contained multiple residues: 85% soils contained 3 or more pesticides and 51% soils 5 or more pesticides. Over half the soils (53%) contained at least 2 pesticides exceeding 0.01 mg/kg. The most frequent compounds were triazine herbicides (present in 89% soils), which were also in significant concentrations (47% soils with triazine sum exceeding 0.01 mg/kg). Based on the association with the occurrence of terbutylazine, it was concluded that independent use of three compounds can also be useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MO122 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer?

P.I. Adriana, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

In current risk assessment of pesticides according to EU Regulation 1107/2009 exposure concentrations are calculated in ponds, ditches and streams in ten FOCUS surface water scenarios distributed across the EU (https://esdac.jrc.ec.europa.eu/projects/surface-water). Currently, these scenarios are based on simulation periods of 12-16 months, so only one application year. However, for more realistic probabilistic assessments a simulation period of about 20 years seems more appropriate. This will result in significantly increased simulation times. For the TOXSWA model simulation times may raise up to approximately 5 minutes for ponds, 15 minutes for ditches and one hour for streams. We investigated whether it would be possible to reduce the simulation time without compromising the accuracy of the predicted concentrations. In the current FOCUS scenarios TOXSWA uses segments of 30 m (ponds), 10 m (ditches, 10 segments) and 5 m (streams, 20 segments) in the numerical solution of the pesticide mass balance describing the concentration in the water layer. This allows to e.g. create concentration profiles as a function of distance in the ditches and streams. To reduce the simulation time rigorously, we cut down the number of segments in the water layer of ditches and streams to one segment. Next, concentrations calculated with a single segment for the water layer were compared to the maximum concentrations in the most downstream segment of the ditch or stream as used in the FOCUS scenarios. We considered maximum and 7 d time-weighted average concentrations both in water and sediment for a range of fictitious compounds. Initial simulations for the 12 and 16 months demonstrated that simulation times greatly reduced by replacing the standard FOCUS segments by a single water segment (still coupled to the standard 14 sediment segments). For the water layer we found that instantaneous peaks lowered up to 11% for ditches, but less than 2% for streams. For the sediment peak concentrations changed up to 20 or 30%, indiscriminately for ditches and streams. Consequently, time-weighted average concentrations also changed, up to 7% both in water and in sediment. Based upon these initial calculations replacing the standard 20 segments in FOCUS streams by one segment could be applied to obtain average concentrations in water, while significantly reducing simulation times.

MO123 Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessments

W. Chen, Syngenta Crop Protection, LLC; P. Mosquin, J. Aldworth, RTI International

Current pesticide regulatory ecological exposure assessments conducted by the U.S. Environmental Protection Agency are almost exclusively based on standard scenario computer modeling. Monitoring data may exist from targeted (prospective or retrospective) programs and for general water quality research by industry, governments, and academic organizations. However, use of the monitoring measured data has been limited in the regulatory assessment process to refine/inform modeling. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timing etc.) and insufficient information regarding the exposure conditions and the context sensitivity of the vulnerability of the monitoring location to a broader regional extent. In this paper, we summarize a set of recently developed approaches to infer and quantify realistic pesticide exposure potential based on monitoring data, including bias factor (BF), universal kriging (UK), and survey statistics. These approaches can be used in a systematic way to provide a useful reality check for comparison with exposure model output in regulatory assessments, thus increasing confidence in decision making. Examples of applying these approaches are provided to demonstrate their usefulness for watershed scale assessments.

MO124 170

SETAC Europe 28th Annual Meeting Abstract Book
Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing

D. Weber, M. Brauer, Eurofins Regulatory AG / Environmental and Ecological Modelling; A. Bolekhan, Bayer AG, Research & Development, Crop Science; G. Spickermann, ADAMA Deutschland GmbH; D. Schaefer, Bayer Crop Science / Environmental Safety

The calculations of the predicted environmental concentrations (PEC) of active substances in surface water are based on a “single year” approach with an initial 6 year warm-up phase followed by 16 months of the year selected by the FOCUS group. Unlike in groundwater with a 20 years assessment period, surface water exposure calculations based on a “single year” approach can be strongly affected by individual rainfall events (EFSA, 2013) which was discussed repeatedly by authorities, industry and academia (Klein, 2013, Goerlitz, 2015, Bach et al., 2016, Poulsen, 2016). This presentation provides background on the technical methods and assumptions currently implemented into a software tool (Weber et al., 2017) that allows 20-year simulations of FOCUS surface water scenarios. In addition, results of a beta test including revealed technical issues, problems and assumptions are discussed. The software tool in its current state can easily be adapted to updated technical requirements or changes, i.e., any comments from official side (EFSA FOCUS Repair Group) or from other sources can be addressed according to given consensus. The aim is to contribute to the development of an improved and generally accepted approach for surface water calculations representing a realistic worst case based on a robust evaluation. Bach M et al. (2016): Pesticide exposure assessment for surface waters in the EU. Part 1: Some comments on the current protection. PveL, Nature Science. 015: 172/174 AG CHR and G. Gassmann (2015): Multiyear FOCUS surface water modelling: Options and Proposals for Realisation. XV: Symposium in Pesticide Chemistry. Placenza, Italy. September 2015 Klein M (2015): Long term surface water simulations using the FOCUS scenarios. Pesticide Behaviour in soils, Water and Air, York, UK. September 2013 Poulsen V (2016): Higher tier assessments of aquatic and terrestrial studies. AGCHEM Forum, Basel. September 2016 Weber et al. 2017: Multi-Year evaluations in the FOCUS Surface Water assessment. Conference Pesticide Behaviour in Soils, Water and Air, York 2017.

MO125 Spatial and temporal explicit catchment modelling in aquatic risk assessment using the modular framework CMF

S. Multsch, F. Krebs, S. Reichenberger, DR. KNÖLL CONSULT GmbH; S. Heine, Bayer AG / Effect modelling; P. Kraft, L. Breuer, Justus Liebig University Giessen / Chair of Landscape, Water and Biogeochemical Cycles; T. Schad, Bayer AG / Environmental Modelling


MO126 Determination of runoff and drainage triggers for PEC surface water using automated simulation with FOCUS models

B. Kind, A. Gucklhand, J. Kleinmann, WS.WaterScientific GmbH

For the zonal registration in the EU predicted environmental concentrations in surface water need to be simulated based on the FOCUS models. Three different entry paths are considered: runoff (simulated in PRZM), drainage (MACRO) and spray drift (SWASH drift calculator). While the latter only depends on the amount sprayed, the distance to the water body and the spray equipment used, runoff and drainage amounts are also triggered by substance properties, e.g. degradation in soil and ad sorption to soil. Often, a lot of runs need to be simulated for different crops or application timings to proof a safe use of plant protection products as defined in the Good Agricultural Practice (GAP). For this poster we evaluate the FOCUS scenarios compared to the substance properties DT_{50} and KOC. The idea is to find DT_{50} and KOC values which trigger runoff and drainage amounts and to distinguish worst-case FOCUS scenarios for different DT_{50} and KOC values. Dummy substances will be created which have different values for KOC and/or DT_{50} in soil. The remaining properties will be identical for each KOC/DT_{50} variation. Using automated FOCUS surface water simulations PECsw values were calculated for different scenarios as different application times within one growing season, spray drift as entry path to focus solely on drainage and runoff. The results for different KOC/DT_{50} values of a single scenario were compared to identify a trigger value for runoff or drainage in this scenario. Furthermore, the results of different scenarios for a single substance will be compared to find the most sensitive scenario for these KOC/DT_{50} values. Finally, the amount of simulations necessary to show a safe use might be reduced to certain worst-case scenarios depending on the DT_{50} and KOC properties of the substance.
Pesticide losses via drainflow are strongly dependent on the soil moisture status at the time of application and the rainfall pattern that follows application. For drainflow simulations, the choice of application date can therefore have a significant influence on predicted environmental concentrations. To standardise the selection of application dates, the FOCUS surface water models include a calculator tool, the Pesticide Application Timer (FOCUS PAT), which selects an application date for each day of the year. To discourage drainflow, a window defined by the user by applying a set of rules to the daily rainfall data used in the simulation. Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004; Pest Manag Sci. 2004 Aug; 60(8); 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil.

MO132

MO131

MO130

MO129

Compiling the FOCUS PAT and CRD PAT rules, and assessing the role of soil

environmental thematics.

monitoring data is well known. In addition, the ratio MEC/

itself the

rules might take place in March

whereas two different algorithms were modified to account for this agronomic restriction. In this poster, the results from the four approaches – namely CRD PAT, FOCUS PAT, CRD Traffic PAT and FOCUS Traffic PAT – are contrasted and compared, with a view to drawing conclusions for the standard and refined UK higher tier drainflow risk assessment process.

MO133

Calibration of passive samplers for the monitoring of chlordecone in French Caribbean rivers

N. Tapie, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; T. Rissier, Univ. Pau et des Pays Adour, CNRS / IPREM UMR 5254; A. Haouisse, Univ. des Antilles / UMR BOREA UA-CNRS7208-IRD207-MNH-UPMC-UCN; P. Pardon, UM CNRS EPOC Universite Bordeaux / EPOC UMR 5805; B. Lauga, Pau et des Pays Adour, CNRS / IPREM UMR 5254; D. Monti, Univ. des Antilles / UMR BOREA UA-CNRS7208-IRD207-MNH-UPMC-UCN; H. Badzinski, Université de Bordeaux

The uncertainty of the tropical weather in the French Caribbean makes spot sampling of chlordecone obsolete and new approaches should be explored to measure the fate of this molecule. To quantify the aquatic pathways, passive and integrated samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordecone: the classical POCIS (Polar Organic Chemical Integrative Sampler) (with Polyethersulfone membranes), the POCISny 30µm (with nylon membranes), and the POCISny 0.1µm. Calculated sampling rates (Rs) were corrected by a PRC (Performance Reference Coupled) approach. Two distinct Rs have been calculated for POCIS; Rs= 0.48±0.50 L.day⁻¹ for NOCIS 0.1µm), and

for the POCISny 30µm. Two distinct Rs have been calculated for POCIS; Rs= 0.48±0.50 L.day⁻¹ for NOCIS 0.1µm, 1.5±4.1 L.day⁻¹ for the POCISny 30µm. Two distinct Rs have been calculated for the POCIS and the POCISny 0.1µm: one for the first five days of the experiment (Rs= 0.19±0.01 L.day⁻¹ for POCIS; Rs= 0.43±0.01 L.day⁻¹) and one for the overall experiment (Rs= 0.19±0.02 L.day⁻¹ for POCIS; Rs= 0.43±0.01 L.day⁻¹). POCISny 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than

for vegetative filter strips (VFS) using additional experimental data

Pesticide losses via drainflow are strongly dependent on the soil moisture status at the time of application and the rainfall pattern that follows application. For drainflow simulations, the choice of application date can therefore have a significant influence on predicted environmental concentrations. To standardise the selection of application dates, the FOCUS surface water models include a calculator tool, the Pesticide Application Timer (FOCUS PAT), which selects an application date for each day of the year. To discourage drainflow, a window defined by the user by applying a set of rules to the daily rainfall data used in the simulation. Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004; Pest Manag Sci. 2004 Aug; 60(8); 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil.

Product GAPs are designed to cover a wide range of application periods to account for seasonal variation, e.g. in dry springs applications might take place in March while in wetter years, when it is more difficult to traffic wet soils, they may take place in April or even early May. When conducting multi-year modelling risk assessments this nuisance is often lost from the risk assessment, and applications are forced into months when farmers would not have been able to travel their lands and apply crop protection products. Using a soil moisture deficit based approach to avoid the risk assessment, even though the limitation and the complexity of usage of FVSMOD (Muñoz-García, Camarena-Perez, et al. 2004; Aug 60(8); 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil.

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in the laboratory calibration (Rs=4.82 ±1.93 L mg⁻¹). POCIS and POCISny samples can accumulate chlordecone efficiently despite its hydrophobic properties. POCIS 30µm seem to be a useful tool to monitor short flash floods, which happen regularly in this area.

MO134 Temporal patterns of pesticide residues in four major river basins in Korea C. Kim, K. Son, Y. Ihm, H. Lee, National Institute of Agricultural Sciences / Department of Agro-food Safety & Crop Protection

To evaluate residues of environmental concerned pesticides which mainly include pesticides used for rice cultivation, total ninety four sampling sites were selected through main streams and branch streams of four major river basins. And the water samples were collected from five times per year from April to July-August, and September-October or November-December in 2012 and 2014. Besides, the water samples at sites of Keum, Mangyong and Dongjin rivers belong to the Keum river basin were regularly collected with a month interval, especially biweekly from May to August in 2013. Of the pesticides monitored, fenoxanil, hexaconazole, isoiprothiolane, iprodione and thifluazamide as fungicides were mainly detected in rice season. While other fungicides including dimethaconazole, procymidine, fenarimol, nuimidol and boscalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphoruses, cadusafos, diazinon, fenitrothion, fenithion, phenthoate and prothiofos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Surface water, which are sampled, monitored, nine pesticides which include alachlor, butachlor, dimethametryn, diethion, ethalfluralin, metolachlor, oxadiazon, simetryn and thiobencar were detected with frequencies of 1-48% and in their residue level of 0.01-1.9 µg/L. Detection frequencies and residue levels of pesticides and insecticides were the highest in waters sampled in May and June. Almost pesticides detected were for the rice plants and their residue levels were very low to compare with standard values.

MO135 Occurrence of 14 representative pesticides in surface and ground waters of the State of São Paulo, the biggest sugarcane producer in Brazil R.D. Acayaba, SCHOOL OF TECHNOLOGY UNICAMP; C. Raimundo, UNICAMP / Institute of Chemistry; A. de Albuquerque, G. Umbuzeiro, School of Technology, UNICAMP / LAEG

São Paulo State is the biggest sugarcane producer in Brazil and the second at pesticide consumption. The aim of this project was to develop a method to determine the presence of 14 pesticides representative from sugarcane plantation, 7 herbicides (simazine, atrazine, ametryn, clomazone, diuron, hexaconazole and tebuthiuron), 3 fungicides (azoxystrobin, carbasazidam and tebuconazole), 3 insecticides (carbofuran, imidacloprid and malathion) and 1 transformation product (atrazine-2-hydroxy) in surface and ground waters using liquid chromatography tandem-mass spectrometry (LC/ESI(SI/MS) and solid phase extraction as sample preparation. Limits of detection (LOD) and quantification (LOQ) were ranged from 0.9 to 22 ng.L⁻¹ and from 2.8 to 74 ng.L⁻¹, respectively, which met the requirement of 66%, which allowed obtaining a sensitive and accurate method for the determination at trace levels. In total, 196 samples located in the main sugarcane area from São Paulo were analyzed (175 surface waters and 21 groundwaters) between October/2015 to October/2016. The most frequently detected pesticides in surface water were atrazine-2-hydroxy (100%), diuron (94%), carbasazidam (93%), tebuthiuron (92%), malathion (91%), imidacloprid (96%) and ametryn (81%). The pesticide that presented the highest concentration for this matrix was imidacloprid, reaching 2579 ng.L⁻¹. The risk to aquatic life were evaluated dividing the maximum environmental concentration of each pesticide by the lowest water quality criteria found in the literature. The potential risk for aquatic life was observed for imidacloprid, carbasazidam, atrazine and malathion. For the groundwater the most frequently detected pesticides were atrazine-2-hydroxy (23%), imidacloprid (14%), carbasazidam (10%), tebuthiuron (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuthiuron, reaching 107 ng.L⁻¹.

MO136 Exposure scenarios for aquatic risk assessment of pesticides in Brazil B. Jene, BASF SE / Environmental Fate; R.P. SCORZA JUNIOR, Embrapa / EMBRAPA AGROPECUARIA OESTE; D. Máximo, R. Rebelo, IBAMA / DIQUA / CGASQ; A.V. Waichman, Universidade Federal do Amazonas / N. Parenginangy, Syngenta Crop Protection, LLC / Product Safety; A. Tomisio, Bayer AG, GenCNS - E-Fate; L. Murakami, Bayer AG Crop Science Division; O. Perez-Ovilia, Bayer CropScience / Environmental Safety; E. Henry, Bayer / Environment Safety; T. Haering, BASF SE

A tri-partite technical working group consisting of regulators, academia and industry was formed to develop a framework for aquatic risk assessment of pesticides in Brazil. The framework should include a sophisticated science-based approach resulting in a comprehensive guidance. The basis of the exposure assessment is the selection of the 90th percentile vulnerability which is seen to represent a reasonable worst case and is used as basis of the exposure assessment in other parts of the world. Surface water scenarios should be identified in six pre-defined climatic zones for the seven most important crops soybean, maize, sugar cane, wheat, cotton, citrus and coffee. Runoff and spray drift were found to be the main entrance pathways of pesticides into surface water bodies. Whereas spray drift mainly depends on technology and local climatic conditions during application, surface runoff is influenced by pedoclimatic conditions that could be assessed in a spatial vulnerability analysis. For this the USDA Runoff Curve Number approach (RCN) which is implemented in PRZM was used. A simple model based on the equations of the RCN approach was developed to calculate daily surface water runoff volumes for the agricultural area of Brazil for 34 climatic years. Calculations were carried out on highest available resolution of soil data resulting in more than 63,000 raster cells. Hydrological soil groups were determined by using a Brazilian specific classification scheme applied to the national soil map. Relative runoff vulnerability for pesticides was estimated with an integrated vulnerability index approach where indices for daily runoff such as average annual number of runoff events and average maximum runoff volume of each year were combined with an index for the expected substance concentration in the runoff water based on organic carbon content of the soil. The 90th percentile relative vulnerability was determined for the relevant crops for each climatic zone to select the relevant surface water scenarios. For the specific crop area, census data on municipality level were used first, but it was decided to switch to satellite images as far as they become available. After discussions in the technical working group the Brazilian environmental authority IBAMA decided to use the US-EPA PWC model for the surface water exposure assessment. Representative flowing and static water bodies which need to be natural and permanent will be defined for each selected scenario.

MO137 Identification of Herbicide Source Areas and Spatial Variability of Dominating Transport Processes in a High Agricultural Intensity Catchment H. Raghiani, M.F. Winchell, Stone Environmental, Inc / Environmental Systems Modeling; W. Sur, Bayer AG Crop Science Division; D. Baets, Bayer AG Crop Science Division / Sustainable Operations; F. Krebs, DR. KNOELL CONSULT GmbH; D. Lembrich, Bayer AG Crop Science Division

The occurrence of herbicides in surface waters of intensively cultivated catchments can originate from a variety of sources. These include transport via runoff and emission during storm events, subsurface transport through lateral flow and through subsurface tile drainages, and from spray drift during applications. The Soil and Water Assessment Tool (SWAT) is widely used in the United States and the EU for catchment scale hydrologic and water quality modeling of non-point source chemicals in the environment. The SWAT model was applied to a 992 ha agricultural catchment in the Flanders region of Belgium to help in better understanding the sources of the herbicides detected in daily sampling over 3.5 years at two locations along the catchment’s primary stream. The SWAT model was calibrated to observed flow and chemical monitoring data, then used to characterize the relative contributions of herbicides via surface processes, subsurface processes, and spray drift. In addition, very vulnerable fields with significant contributions to surface water exposure were identified. A quantitative comparison between monitoring data and simulated exposure profiles was made to single out those high residue concentrations that could not be attributed to any of these traditionally considered exposure pathways, and could ultimately be explained by point source contributions. The model results demonstrate that SWAT is capable of simulating streamflow in a small agricultural catchment, and is capable of simulating diffuse source pesticide concentrations. This allowed application of an approach that incorporated model results with distinguishing between diffuse source dominated high concentrations from those most likely affected by point sources. The SWAT model also proved useful in identifying the spatial variability in the dominant transport processes contributing pesticide residues to the stream. While surface runoff of soluble pesticide was the major non-point source contributor on most fields, lateral subsurface flow was found to be important as well, especially in the western portion of the catchment. Spray drift is likely the least significant contributor at the catchment scale. Overall, the analysis of monitoring data and modeling results shows that the potential for reducing herbicide concentrations in the study catchment can be addressed by mitigating both point source contributions from farmyards as well as diffuse sources.


The Douro River is an international water river that passes through extensive agricultural fields, of both Portugal and Spain, before reaching the estuary at Porto and Gaia cities. Therefore, the presence of pesticides is suspected. Accordingly, the evaluation of 56 pesticides of different categories (insecticides, herbicides, and fungicides) should be viewed as a priority for this habitat due to their negative impacts on the biota. For this purpose, water was collected over one year at six sampling sites in the Douro River estuary. Samples were extracted by solid-phase
extraction and quantitatively analysed by gas chromatography–mass spectrometry (GC-MS). Results show that 96% of measured pesticides were detected in 79% of the quantified samples and that twelve compounds showed concentrations well above the limits established by the 2013/39/EU Directive. Individually, the concentrations of the analysed pesticides ranged from 39 to 1265 µg/L. Since the occurrence of these compounds happens in mixtures, we conducted a theoretical hazard assessment considering the average and the maximum environmental mixtures of all measured pesticides. The theoretical approach suggested that invertebrates were the most sensitive group. Therefore, short-time exposure in vivo assays using Artemia salina and Daphnia magna were done. These results disclosed significant toxic effects of the analysed mixtures - high mortality rate and abnormal swimming behaviour - over the exposed animals. Both approaches (theoretical and experimental) showed a clear contribution of pesticides used in the needed conditions on this estuarine environment and of other comparable. Acknowledgements: European Regional Development Fund (ERDF) through COMPETE, Framework of the Structured Program of R&D&I INNOVMAR – Innovation and Sustainability in the Management and Exploitation of Marine Resources (NORTE-01-0145-FEDER-00035), Research Line ECOSERVICES, supported by the Northern Regional Operational Programme (NORTE2020), through the ERFD. ICBAS – U. Porto.

Keywords: monitoring, Artemia salina, Daphnia magna, pesticide mixtures

MO139 Monitoring programme to investigate the presence of myclobutanil and its soil metabolite in Italian groundwater following use in pome fruit, stone fruit and vineyards

G.L. Reeves, Dow AgroSciences Ltd; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences;

C. Vali, Dow AgroSciences Italia s.r.l.; R. Bradascio, Dow AgroSciences Italia s.r.l. / Department of Earth and Environmental Sciences.

Myclobutanil is a fungicide used mainly in pome and stone fruit areas, and in vineyards. For national registration in Italy, FOCUS groundwater modelling showed that the PECgw for its soil metabolite (X1129885; up to 6% of applied) reached up to 2 µg/L. This was accepted at EU level since the metabolite is not toxicologically relevant. However, according to national rules, this triggers a groundwater monitoring study for a metabolite when the PECgw is >0.75 µg/L. For completeness, myclobutanil was also monitored. To allow for a robust monitoring study, it was necessary to identify monitoring areas with the following characteristics; (i) be representative of an intensive use of myclobutanil, and (ii) reflect reasonable worst case scenarios for Italy. To facilitate this, a GIS-based indicator (PLI: Potential Leaching Indicator) was developed to integrate information about sales data, the spatial distribution of the target crops and the distribution of the FOCUS groundwater model scenarios throughout Italy. Use of the PLI allowed five suitable areas to be identified (Bolzano and Trento for apple trees, Verona for stone fruit and grapes, Forlì-Cesena for pear trees and stone fruit, and Matera for stone fruit). These areas are also representative of the FOCUS groundwater scenarios relevant in Italy (Châteaudun, Hamburg, Piacenza and Thiva). In each area, five monitoring wells were identified to cover a range of parameters (depth to groundwater, hydrology, pedology, and presence of the target crops). Subsequently, a three year monitoring campaign was conducted (autumn 2014-spring 2017). From a total of 150 samples analyzed, the concentrations of myclobutanil and its soil metabolite (X1129885) were below the LOD (0.001-0.002 µg/L) 94% of the time. In detail, the number of positive detections was 23 and of these, 20 samples showed concentrations well below 0.01 µg/L. Only in one sample did the measured concentration exceed the trigger value of 0.1 µg/L. However, a number of factors indicate that this is due to point source origin. Even better results were obtained for X1129885 where the number of positive detections was only 13, with concentrations less or very close to 0.01 µg/L. Based on these results it can be concluded that given the actual use conditions, the probability of myclobutanil and its soil metabolite exceeding the threshold value of 0.1 µg/L in groundwater in Italy is very low.

MO140 Identification of areas at risk of groundwater leaching in Italy for the fungicid 1,3-dichloroprene

R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences; R. Bradascio, Dow AgroSciences Italia srl / RD; C. Vali, Dow AgroSciences Italia srl; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences.

1,3-Dichloroprene (1,3-D), also known as Telone™, is an active substance used worldwide in soil fumigant products for the control of cyst and free-living nematodes. It is used in a variety of crops including fruiting and vegetable crops. Soil sorption studies have shown that 1,3-D and its metabolites present characteristics of highly mobile molecules with a potential to leach into groundwater when applied in vulnerable areas such as sandy soil and in areas characterized by shallow groundwater. European member states have a wide range of groundwater monitoring activities for plant protection products and their metabolites, but analysis of 1,3-D and its metabolites is not currently part of the routine programme. In this study we illustrate a methodology allowing to identify areas most at risk where monitoring should be focused in priority, taking the example of Italy. The methodology considers three parameters: i) crops distribution, ii) soil properties and iii) 1,3-D use. The data, structured as layers of information are managed within a GIS, and are intersected to get the so called Uniform Geographic Units (UGU) which are areas of uniform in their characteristics and are representative of a specific set of values parameters. The data about the spatial distribution in Italy of crops where the 1,3-D is applied were first gathered from the last agricultural census, which provide information at a provincial scale. Successively, these data were refined at municipality scale. The identification of sandy soil areas in Italy was performed using pedological information extracted from different official sources. Subsequently, the information was then processed to identify sandy soils areas in which crops could be grown. In Italian regulations, sandy soils are defined as soils falling among three different categories (< 60%, 60-80%, >80%). Also these data were structured as GIS layers, which were processed and represented using the same GIS of the crop distribution. Overlaying the crop distribution and sandy soil areas and by merging the two databases, it was possible to identify sub-communal areas where crops and sandy soils coexist, characterizing the extension in relation to the rest of the municipality and the province. Finally, by considering 1,3-D sales data, it was possible to refine the areas previously identified and quantify the percentage of areas potentially at risk of leaching where Telone™ is applied. TM of DowAgroSciences

MO141 Development of an European Tier 3+ Spatially Distributed Modelling Framework

G. Hoogeweg, Waterborne Environmental, Inc / Data Technologies; P. Sweeney, Syngenta

Higher tier groundwater assessment in the European Union (EU28) allow the use of spatially distributed modeling approaches for the assessment of groundwater and exposure of soil organisms to use of a distribution of point sources. The models can reflect local conditions and capture the spatial variability of the landscape and weather patterns. An advanced modelling framework, based on the GeoPEARL 4R model was developed for the EU28. This model fills the niche for higher Tier assessments needs. This modelling framework represents over 1,340,000 km² of arable agricultural lands in Europe. Nearly 382,000 unique soil layers, weather, FOCUS zone combinations represent the variability of the landscape and climate. Datasets to populate the model, included CORINE land cover, soils data (ESDB, ESDB Derived Data for Modelling and HYPRES, EFSA organic matter) and the JRC MARS 25km gridded daily weather data. Agricultural management practices, irrigation, and cropping scenarios are gleaned from the standard FOCUS model recommendations, but can be updated as needed. The FOCUS groundwater modelling framework (EMF2014) can be used for EU28, member state, FOCUS zones or crop specific groundwater vulnerability assessments, screening of existing and new plant protection products, context setting of standard scenarios, test sites, and lysimeter, site selection. In this presentation we will show how we developed the framework and several example outputs as well as discuss the implications of conducting large-scale distributed modelling assessment.

MO142 Influence of aquifer parameters on groundwater residue concentrations

F. Hegler, DR. KNOELL CONSULT GmbH; D. Liss, SGS Institut Fresenius GmbH / Agro; W. He, DR. KNOELL CONSULT GmbH; N. Naeh, SGS Institut Fresenius GmbH; S. Reichenberger, DR. KNOELL CONSULT GmbH / Agro; O. Naeb, SGS Institut Fresenius GmbH / Environmental Fate / Modelling / GIS

FOCUS leaching models are used in a regulatory context to calculate pesticide leaching flux concentrations in 1 m depth (PECgw; “Predicted Environmental Concentrations in groundwater”) from the unsaturated to the saturated zone. These values are used in risk assessments to evaluate the impact of plant protection products on groundwater. In higher tier groundwater monitoring studies the properties of the saturated zone add additional complexity influencing actual pesticide residue concentrations in shallow groundwater. In this work the impact of groundwater flow velocity and aquifer porosity on groundwater residues for a defined leachate concentration (i.e. decoupled from the unsaturated zone) was determined. In a sensitivity analysis of a distributed model, the influence of aquifer parameters the impact on the resulting residue concentrations in groundwater was quantified. For the sensitivity analysis FOCUS model outputs for selected scenarios were combined with realistic aquifer parameters for some representative regions in northern Italy and Germany. In these regions the relevant shallow aquifers are variable in terms of hydraulic conductivity, gradient and effective porosity and provide a representative parameter range.

MO143 Implications of Dataset Selection and GIS Processing on Modelling

G. Hoogeweg, Waterborne Environmental, Inc / Data Technologies; M. Guevara, Waterborne Environmental Inc / Modeling

Groundwater assessment guidelines provided by the FOCUS groundwater working group (2009) and EFSA (2014) describe succinctly a multi-tiered modelling framework that includes spatio-temporal assessments in the higher tiers; e.g., tier 3a and 3b. As part of the spatio-temporal assessment several GIS and daily climate
datasets were recommended. These recommended datasets, however, have been superseded by new datasets in the past few years. Specifically, daily weather and soils data have undergone significant updates, which are reflective of the considerable effort in Europe to update this spatial information. Not only does dataset choice, but also how datasets are being processed in a geographic information system, impact modeling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution influence our modelling results. In this poster, we will show the implications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 4R. Specifically we will focus on differences between datasets, data set resolution, capturing variability and ones ability to model at the pan-European level within EFSA’s tier 3 guidelines.

MO144
Combining specific and public groundwater monitoring data as higher tier for pesticide regulatory risk assessment
A. Boivin, ANSES
Pesticides risk assessment for groundwater in France is performed according to Regulation 1107/2009. The European tools are routinely used by considering the same models and same tiered approach. Groundwater monitoring data are identified as higher tier that may supersede modelling. Still, there is currently no agreed guidance available on the use of groundwater monitoring data for regulatory purposes. Work is ongoing on behalf the SETAC-EMAG GW group (www.setac.org/group/SEAGPot). The main issues when dealing with groundwater monitoring data interpretation were stated to site selections and related vulnerability, and then of how representative was the groundwater monitoring. In recent case, usefulness of the groundwater monitoring programs submitted at EU level as been questioned. Notably, the groundwater hydrology including its vulnerability and how representative / which situations the test sites might be considered to cover were not seen as not being properly addressed. Monitoring programs have also been submitted and assessed at national level mainly to refine metabolite groundwater risk assessment. Combined information from targeted and public monitoring were keys to address the representativeness of monitoring programs. The French groundwater public network (wells) is vast and the database is available online (www.ades.eaudefrance.fr). This databased (ADES) is owned by the BRGM (French Geological Survey). This database mainly active substances, more metabolites will be included in the future Proposals to combine targeted together with public groundwater monitoring dataset were made to enhance the representativeness of the GW monitoring conducted.

MO145
Minimal variation in input parameters highly influences PEARL and PELMO results: how can these results be trustable?
S. Ullucci, ICPS; L. Menaballi, International Centre for Pesticides and Health Risk Prevention
The calculation of Predicted Environmental Concentration of pesticides in groundwater (PECgw) is a crucial point in the registration authorization process of plant protection products (PPPs) in Europe. Calculations are usually performed by FOCUS models, in particular PEARL and PELMO models. These models allow a realistic but conservative assessment of the potential leaching of pesticides in the groundwater compartment. Model results are influenced by substance specific parameters such as DT50, KOM and Freundlich coefficient (1/n). Great variations in PECgw values are expected when high variabilities occur in one or more of the parameters listed above. In this work, we demonstrate that PECgw outputs are significantly affected also by minimal variation of the same parameters. Considering that a minimal variation is intrinsic in all laboratory studies (es. 25% uncertainty in KOM determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically acceptable. In a previous project (York, 2017), dummy substances with different combinations of DT50, KOM and 1/n values were used in FOCUS PEARL, in order to quantify the influence of each single parameter on the final PECgw. It was verified that the sensitivity of PEARL model can be considered quite excessive. In this follow-up project, further calculations were performed using FOCUS PELMO to confirm the sensitivity of these two models, commonly used in a regulatory context. Leachate concentrations were plotted as a function of KOM and as a function of degradation rate coefficient. PECgw obtained by the simulations of these two models were used to create a classification system for the input parameters KOM and DT50 according to models sensitivity. Conservative values for each parameter class, to be used in PECgw calculations, are proposed for all substances. This approach can minimize the effects of the intrinsic input variability providing a better scientific approach to the assessment of groundwater modelling in the regulatory context.

MO146
European regulatory network on pesticide groundwater monitoring
A. Gimnès, The Danish Environmental Protection Agency / Pesticides and Gentechology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cggb; A. Schwem, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tütting, German Federal Office of Consumer Protection and Food Safety
Groundwater monitoring data should be included in the assessment of the leaching risk of pesticides and their metabolites. Monitoring data is generated in most European countries, but their use for leaching risk assessment during pesticide authorization is hampered due to the following reasons: (i) The data is often not publicly available or available only in an aggregated form in a report, (ii) most of the data is not available in the national language of the origin country, which makes it hard for other countries to access it, and (iii) the interpretation of data. Groundwater monitoring requires detailed knowledge of the local geological, hydrological and climatic conditions, and also knowledge about crops and the use pattern for pesticides. To overcome these difficulties, a network among regulatory authorities in Europe involved in groundwater risk assessment of pesticides is proposed. The aim of this network is to exchange pesticide groundwater monitoring data and frequent updates about the focus of national monitoring, and to assist each other in the interpretation of the data. The network plans to have its first meeting in Copenhagen, Denmark, in September 2018 with an invitation to all interested European countries to participate. The poster will present the thoughts about the network and the status of the start-up, and aims at promoting the network to interested authorities.

MO147
Overview of measured wash-off factors from experiments suitable to derive a refined input for FOCUS modelling
G. Reinken, E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; D. Sossaud, Bayer Crop Science / Environmental Safety
Recent regulatory interest in the wash-off process resulted in a proposal to the effects of wash-off should be generally considered as additional soil loading for FOCUS modelling of foliar applied pesticides (EFSA 2010, 2016). EFSA also proposed to increase the default wash-off factor for FOCUS modelling from 0.5 cm-1 to 1 cm-1 (EFSA 2012). On the other side, EFSA has stated that effects of wash-off should be not considered as an additional worst case but rather as average effect (EFSA 2015, 2017). The default wash-off factor of a compound is a product (formulation) specific modelling input parameter that can be experimentally determined. A generic experimental study design has been derived in a workshop organised by the European Crop Protection Association (ECPA). This study design was used for the experimental determination of wash-off factors for modelling purposes. Overall 25 individual wash-off factors have been determined experimentally, mainly under GLP. The data set comprises 12 formulations, 8 compounds and 6 crops. Experiments consider one heavy rainfall event of 15 mm over one hour, applied 24 hrs after foliar pesticide spray. The determined wash-off factors are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set. This experimental evidence does not support the proposal to increase the existing default wash-off factor from 0.5 cm-1 to 1 cm-1. EFSA 2010: PPR Technical Guidance 4.2 - Outline on exposure of organisms in soil EFSA 2012: Scientific Opinion 2562 – Science behind the guidance on soil scenarios EFSA 2015: Guidance Document 4093 - Predicting environmental concentrations in soil EFSA 2017: Guidance Document 4982 - Predicting environmental concentrations in soil

MO148
Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions
G. Reinken, M. Beckmann, Bayer AG, Research & Development, Crop Science / Environmental Safety; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; U. Köhler, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamsoeff, Bayer CropScience AG / R&D; S. Sittig, DR. KNOELL CONSULT GmbH / E-Fate Modelling
In recent regulatory discussions about the plant uptake process the question was raised if tracer-like substances (very low or zero sorption, very slow or no degradation) are fully available for uptake by plant roots under dynamic outdoor conditions. An alternative hypothesis is that such substances move so quickly in the soil column that they are taken up by plant roots to a lower extent than indicated by static laboratory plant uptake studies. To address this particular question an outdoor container study was conducted with 14C-labelled trifluoroacetic acid (TFA) and winter wheat plants for a time period of 228 days after application onto soil. Trifluoroacetic acid is a common breakdown product of several chemical pharmaceuticals, pesticides, pyrolysis of PTFE (used as coating in many products like Teflon® or Gore-TEX®). Plant root uptake of TFA under static conditions has been determined in parallel with experiments using plants growing in nutrient solution (hydroponic study design). The translocation and uptake of trifluoroacetic acid observed in the outdoor container study was evaluated with the FOCUS model considering root uptake processes as routinely applied in standard FOCUS modelling. A transpiration stream concentration factor (TSCF) for TFA under cereal growing outdoor conditions could be derived. The results demonstrate that mobile, tracer-like substances are taken up extensively by plant roots even
under dynamic outdoor conditions; the hydronic study design is suitable to determine conservative input parameters for regulatory modelling; uptake experiments with cropped outdoor container may be suitable as higher-tier to derive a refined TSCF. Further experiments will indicate to which extent this study design is also suitable to derive refined TSCF for compounds with other sorption and degradation properties.

MO149 Investigating the variance of edge-of-field deposits of spray drift H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

Spray applications in arable crops often lead to off-target spray deposits downwind from the treated field. Throughout several decades, many experiments have been carried out by different researchers to quantify the downwind spray deposits. Relations between downwind spray deposits and parameters like sprayer settings, field conditions and environmental conditions were investigated. Still, there is a large variance in the observed data that cannot be explained satisfactorily by the experimental and environmental conditions. In the study described here, the variance in spray deposits was investigated in potato fields sprayed using an Informatics System (IFS) - coupled with a wind and solar sensor. The IFS collects spray deposits and meteorological conditions in the field. The wind was predicted using the IDEFICS spray drift model and was validated using wind sensors. The spray deposits were measured using a grid of 30 cm spaced monitoring points and with a weighing technique. The results indicate that the variance in spray deposits is related to wind speed and wind direction, and can be expressed as a variance factor (Vf) that is a function of wind speed and wind direction. The variance factor can be used to estimate the variance of spray deposits in new situations.

MO150 Exposure assessment for edge-of-field watercourses next to tree nurseries regarding spray drift deposits H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

In the Netherlands, about 90,000 people live within 50 m of flower bulb or fruit cultivation. It is unclear how many of these people are exposed to pesticides or whether their health is at risk. Recently, a research project was launched to assess the exposure of residents to pesticides next to flower bulb fields. This research projects involves both measurements and simulations of airborne spray drift. Downwind spray deposits of spray drift were measured alongside a treated tree nursery field. Consequently, the part of the spray that is deposited on the field was carried out. For dermal exposure measurement, whole body dosimetry of the treated field was carried out. For dermal exposure measurement, whole body dosimetry was used. The results indicate that potential exposure of residents to pesticides used when treating nearby fields may be significant and further assessment of this exposure route is important.


Airborne spray drift is no recent guidance on how to conduct a risk assessment for consumers for co-formulants present in plant protection products. One of the reasons is the lack of exposure data when the product containing its co-formulants is applied onto crops. To our knowledge only one software is predicting the level of crop residues of chemicals after application i.e. PARDIS [1] Prediction of Agricultural Residue Data Set. So the use of an Informatics System however is limited to orchards. In addition in the case of polymers, from an analytical point of view it may be difficult if not impossible to analyse the crops for residue content of this type of co-formulate. The objective of this work is to develop a methodology to be applied under this conditions. As a case study we present this methodology for latex polymers i.e. polymer based on methylene succinic acid with buta-1,3-diene, styrene and methacrylic acid. [1] Prediction of agrochemical residue data on fruit using an informatics system (PARDIS model), Calliera M, Balderacchi M, Capri E, Trevisan M. 2008

MO153 Dietary exposure to pesticide residues: the big picture L. Villamar Bouza, L. Ferreira, EPSA - European Food Safety Authority / Pesticides Unit

Science-based approaches and integrated risk assessment by using experimental data, models for pesticide residues intake estimations, monitoring data considering real exposure, etc. are working tools to contribute to the mission of the European Food Safety Authority (EFSA) on protecting European consumers’ health and the environment in the field of pesticide residues. Maximum residue levels (MRLs) vary from the upper levels of pesticide residues that are legally permissible in food of plant and animal origin. Before an MRL is established, the EFSA assesses the residue behavior of the pesticide and the dietary exposure resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues are estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the international agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumers are exposed in the diet. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and its transformation, the possible uptake and translocations of the residue to the edible parts of the crop and degraded products as result of industrial and household processing are considered to set the residue definitions for risk assessment purposes. Secondary metabolites characterized by metabolism studies and degraded products may pose a completely different toxicological profile than the parent compound, being more, less or equal toxic than the pesticide under assessment, and showing a new big picture for an active substance and its residues that should be assessed in detail to avoid consumers’ concerns. The dietary risk assessment of pesticide residues takes into consideration these possible scenarios in order to protect consumers, reason why residue definitions might be different for monitoring and for risk assessment purposes and where the uncertainty due to missing data might play a fundamental role in risk assessment.

MO154 Exposure and Risk Assessment for Agricultural Applicator to Insecticide Fluabendiamide during Cabbage Cultivation using Whole Body Dosimetry J. Lee, Seoul National University / Department of Agricultural Biotechnology; Y. Shin, Seoul National University; J. Lee, College of Agriculture Sciences Seoul National Univ / Agricultural biotechnology; J. Lee, Seoul National University / Department of Agricultural Biotechnology; B. Kim, Seoul National Univ.; E. Kim, H. Ryu, Seoul National University / Department of Agricultural Biotechnology; D. Jeong, Seoul National Univ.; X. Yuan, Seoul National University / Department of Agricultural Biotechnology; E. Park, S. KIM, Seoul National Univ.; M. Rehan, Seoul National University; J. Kim, Seoul National University / Department of Agricultural Biotechnology

Fluabendiamide belongs to diamide insecticide that has been used to control a wide range of insects in fruit and vegetables. Assessment for agricultural applicator’s exposure was carried out during application. Outdoor and indoor experiments were conducted. In a simulation experiment, the applicator was exposed to 10 mg/m³ concentration of the compound in field. For dermal exposure measurement, whole body dosimetry (WBD) was performed, which consists of cotton/polyester outer clothes and cotton inner clothes. Hand exposure was measured by washing of nitrile gloves and hands, while head exposure was monitored by face/nose wipe technique. Inhalation exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–109%). Field exposure exposure was carried out by 8 replicates. During application, total
dermal exposure of flubendiamide was 3635.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubendiamide (688.7 μg) in mixing/loading was higher than the case of application (680.8 μg). Exposure of body was highest (42.0%) in case of application. Penetration rate of insecticide between outer and inner dosimeter was about 0.5% (upper body) and 5.9% (lower body). Inhalation exposure during application was 202.2 μg while in case of mixing/loading no exposure was observed. Risk index (RI) was calculated to be 0.09 using 6 μg/kg/day of acceptable operator exposure level, suggesting that health risk of agricultural applicator during treatment of flubendiamide for cabbage field would be minimum. Keywords: Flubendiamide, exposure, risk assessment, whole body dosimetry, IOM, cabbage *Corresponding author: kjh2404@su.ac.kr; Tel, 82-02-880-4644

MO155 Multi-focus Surface Water Calculations: What do they mean for real regulatory cases?
D. Schaefer, Bayer Crop Science / Environmental Safety; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety; A. Bolekhan, Bayer AG, Research & Development, Crop Science; S. Heine, Bayer AG / Effect modelling; G. Goerlitz, Bayer CropScience AG / Environmental Safety
The surface water exposure calculations for pesticides according to FOCUS are currently under revision by an EFSA working group. In particular the working group was mandated to extend the calculation period from a preselected single year to 20 years, with the objective to better capture the effect of variable weather conditions in aquatic exposure patterns. This is meant to provide a more robust and reliable basis for aquatic risk assessments in a regulatory context. The planned revision requires decisions on some technical aspects of the calculations (e.g. evaluation of the original FOCUSss weather data, filling of data gaps, completion of irrigation data sets, definition of multi-year application dates) and also new rules for the interpretation of the results. The main challenge in this context is the lack of exposure calculations with flow and runoff calculations. Surface water exposure is strongly driven by individual weather events triggering run-off or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-year calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted such an investigation by running multi-year FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We discuss our experiences with the calculations themselves, and present exposure characteristics of the different test substances. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the EFSA working group has to take.

MO156 Effectiveness of grass buffer strips in reducing Spinosad runoff
S. Otto, Italian National Research Council, S. Gottardi, M. Pasini, Agrea SRL; R. Biondi and A. Friel°, Dow AgroSciences Italia srl / RD; O. de Cirugeda Helle, Dow AgroSciences
Outcome from FOCUS and a recent Document from Italian Ministry of Health allows vegetated buffer areas as a mitigation measure for runoff to surfact water. The modelling framework includes default values relating to the pesticide removal efficiency of such buffers. Recent research suggests that these default removal efficiency values (10% for flow through and 80% for sorption) are derived values specific to Spinosad may be useful in demonstrating compliance. A GLP field study was performed in summer 2017 to test vegetated buffer strip removal efficiency, in relation to Spinosad and its major metabolites, and based to the FOCUS Surface Water risk assessment scenarios, but with worse (and prudential) conditions. The selected site was near Verona, in a hilly zone rich in vineyards and famous for high-quality wine production. Runoff containing a known amount of each of the four spinosad components to be tested (the parents – spinosyn A and spinosyn D; and the metabolites – spinosyn B and spinosyn B of D), have been artificially applied to 9 grass plots of 4.2 m width and 12 m length, with sandy-loam soil and slope ranging from 10 to 13%. Natural vegetation cover was 60-90%. The artificial runoff was organized to simulate rainfall events generated in a source area of 500 m² flowing in a run-on area (buffer area) of 50 m², to evaluate its buffer capacity both in runoff displacement and concentration. Runoff event consisted in 2 phases: 1) Irrigation with sprinkler at 14 mm/h for 50 min (total: 75 min), to simulate the rain runoff or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-year calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted such an investigation by running multi-year FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We discuss our experiences with the calculations themselves, and present exposure characteristics of the different test substances. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the EFSA working group has to take.

MO157 EFSA’s innovative guidance on the establishment of the residue definition for dietary risk assessment
R. Leuschner, EFSA - European Food Safety Authority / Pesticides, Regulated Products (REPPO); A. Friel°, EFSA - European Food Safety Authority / Pesticides Regulated Products REPPO
*The positions and opinions presented in this poster are those of the authors and are not intended to represent the views or scientific works of EFSA Commission Regulation (EU) No 283/2013 setting out the data requirements for pesticide active substances provides that the toxicological significance of compounds and their amount likely to be present shall be considered when judging which compounds are to be included in the residue definition for dietary risk assessment. In particular the working group has to take.

The EFSA guidance is intended as a practical instrument helping risk assessors, on the basis of factual information (derived from toxicological and metabolism data), non-animal testing methods, by weight of evidence, to transparently: Conclude for which residues of a pesticide on food and feed commodities a hazard identification and characterisation is needed; Perform such a hazard identification and characterisation; Define the compounds that should be included in the residue definition for risk assessment. The innovative aspect of the EFSA guidance is a structured sequence of three modules, each of which addresses hazard characterisation and dietary exposure by selecting genotoxicity as the starting criteria for human health assessment. The modules are: Module 1: Exclusion of genotoxicity; Module 2: General toxicity assessment; Module 3: Decision making for residue definition for risk assessment. The guidance provides as appendices an analysis of ADI and ARfD distribution for pesticide active substances and three case studies illustrating the practical application of this modular approach to derive a residue definition for dietary risk assessment for isoproturon, spiroxamine and propazine. In September 2016, EFSA organised a technical meeting9 with stakeholders on its new guidance to exchange views. 1EFSA PPR Panel (EFSA Panel on Plant Protection Products and their Residues), 2016. Guidance on the establishment of the residue definition for dietary risk assessment. EFSA Journal 2016;14(12):4549, 129 pp. doi:10.2903/j.efsa.2016.4549. 9OECD (Organisation for Economic Co-operation and Development), 2009. Series on testing and assessment No. 63 and Series on pesticides No. 31 Guidance document on the definition of residue; ENV/JM/MONO(2009) 30; 28-Jul-2009. 9Info session on applications – pesticides - technical meeting with stakeholders on EFSA GD on residue definition for dietary risk assessment. http://www.efsa.europa.eu/it/events/event/160926

Alternative Approaches to Animal Testing for Ectotoxicity Assessments (P)

MO158 Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca
C. Schloetter, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Hollender, Eawag / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; V. Kosfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esser, A. Schulte, Fraunhofer IME; I. Ebersbach, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; I. Bischof, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology IME. Bioconcentration factors (BCF) are needed for regulatory purposes to assess the bioaccumulative characteristics of a substance in the aquatic environment. Traditionally these BCFs are determined in fish flow-through tests according to TGD OECD 305. These fish bioaccumulation studies are time consuming, expensive, and demand many laboratory animals. Accordingly, alternative methods that replace, reduce and refine (3Rs) this test system are needed. Two promising alternative test approaches have been developed as alternative to in-vitro BCF testing: I) An invertebrate flow-through bioconcentration test system using the freshwater amphipod Hyalella azteca and II) in vitro deployment assays with rainbow trout hepatocytes or rainbow trout hepatocyte S9 fractions. Flow-through test with almost 20 compounds showed, that the H. azteca bioconcentration test could be an appropriate test to predict bioconcentration in the standard fish test. Bioconcentration studies with H. azteca would support laboratory animal welfare considerations using a non-vertebrate species, improve efficiency and reduce costs for BCF-testing. The results of the in vitro deployment assays have been successfully applied to improve in-silico predictions for BCF values by adding the highly variable aspect of metabolism capacity to the existing BCF prediction of this tool. In this study a total of five substances with different characteristics, four substances with log Kow values ranging from 2.5 to 4.5 and one ionic substance, were tested both test systems. To obtain a more detailed understanding of the metabolic activities in H. azteca, its metabolism of the five tested compounds were compared to the metabolites generated in vitro by rainbow trout hepatocytes. The results show that Hyalella BCF testing, in addition to in vitro assays and in silico predictions, may help to reduce, refine, and replace the classic BCF estimation with fish in accordance to regulatory needs.
MO159 Assessing Differences in Sensitivity to Aromatase Inhibitors Among Freshwater Fish Species

J.A. Doering, US EPA / Mid Continen

There is significant concern regarding potential impairment of fish reproduction associated with exposure to endocrine disrupting chemicals (EDCs). Aromatase is a steroidogenic enzyme involved in the conversion of androgens to estrogens. Inhibition of aromatase activity by exposure to chemicals can reduce levels of circulating estrogen leading to reduced synthesis of vitellogenin and production of fewer eggs by females. This mechanism has been extensively studied in the laboratory model species, fathead minnow (Pimephales promelas). However, differences in sensitivity to inhibition of aromatase among species of fish is largely unknown. This is particularly true for species that are not routinely studied in short-term reproduction assays, including many fishes of significant ecological and economic importance such as catfish (Ictaluridae), eel (Anguillidae), and perch (Pericidae). This study investigated in vitro inhibition of aromatase by the model inhibitor, fadrozole, fadrozole, across eighteen phylogenetically diverse species of freshwater fish. Concentrations of fadrozole that result in 50 % inhibition of in vitro aromatase activity (IC50) were determined for 72 species. This suggests that intrinsic differences in sensitivity to inhibition of aromatase could be greater than 60-fold among fishes. Paddlefish (Polyodontidae), white sucker (Catostomidae), rainbow trout (Salmonidae), and fathead minnow (Cyprinidae) were investigated for sensitivity to in vitro inhibition of aromatase by four additional inhibitors. Potencies of letrozole, imazalil, prochloraz, and propiconazole relative to fadrozole were comparable among paddlefish, white sucker, rainbow trout, and fathead minnow despite up to 40-fold difference in sensitivity to fadrozole. This suggests that relative potencies generated for a model species, such as fathead minnow, could be applicable across diverse species, despite great differences in relative sensitivity. Results of this study are being used in the construction of a cross-species quantitative structure-activity (QSAR) model for bioavailability of chemicals to estrogens. The bioavailability data as a relative-sensitivity adjustment for prediction of impacts at the individual and population level. This information could guide more objective ecological risk assessments of native species to EDCs that inhibit aromatase. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO160 Fish scales as a tool for temporal biomonitoring of trace element concentrations

D.A. Vignati, CNRS / LIEC UMR7360; G. Masson, Université de Lorraine and CNRS / LIEC UMR7360

Direct measurement of contaminant concentrations in biological tissues is attractive for toxicology purposes because it accounts, in principle, for the environmental factors controlling their bioaccessibility and bioavailability. In the case of trace elements, the validity of this approach is confirmed by its adoption in the regulatory European framework for mercury measurement in fish. For other elements, the current framework privileges measurements in the dissolved (filterable) aqueous matrix. However, this approach provides only a limited temporal resolution of possible trends in elements’ concentrations and, where relevant, neglects uptake via dietary pathways. Furthermore, when fish is the selected matrix for monitoring, one or more individuals have to be sacrificed to collect the material necessary for analysis; a strategy that, apart from the associated ethical problems, may become problematic in situations where the number of resident fishes is limited. In this context, fish scales, as a bioindicator, constitute a potential tool to investigate temporal trends of trace elements. In this work, we report the analyses of fish scales from the rivers Sella and Ticino. The results have shown a temporal variability in the concentrations of Cu, Zn and lanthanides in fish scales from these rivers. The concentrations of these elements have been monitored over a period of 15 years (1990-2014) in the Sella and 10 years (2002-2012) in the Ticino. The results have shown a positive correlation between the concentrations of Cu, Zn and lanthanides in fish scales and the concentrations of these elements in the environmental media. This suggests that fish scales can be used as a tool for monitoring temporal trends of trace elements in fish and their environment.
Department of Theoretical and Applied Sciences (DiSTA); E. Caruso, University of Insubria / DISTA; S. Zucchi, S. Sterpone, E. Ferri, TRUSTICERT SRL

Electronic cigarettes (e-cigarettes) are devices that typically deliver nicotine, flavors, and other additives to users via an inhaled aerosol. They are designed to closely mimic the experience of smoking conventional cigarettes. Nowadays, e-cigarettes are the most commonly used tobacco-related product among youth, surpassing conventional cigarettes in 2014. However, insufficient data is available to definitively predict their potential aerosol to which consumers are exposed; at the same time studies evaluating whether e-cigarettes are less harmful than cigarettes are inconclusive. Minimal valid chemistry data are available on e-cigarette emissions and no standardized methods and threshold values exist for e-cigarette analysis. To fill the chemical and toxicological data gaps, comprehensive assessment of e-cigarette emissions and toxicological studies are certainly needed. The aim of the present study is to provide, by means of Quantitative Structure-Activity Relationship (QSAR) approaches, a first toxicological screening of several e-liquids ingredients. Different Ordinary Least Squares (OLS) regression-based QSAR models were developed to define the potential acute toxicological profile of 265 molecules contained into 265 e-liquids. Chemical data were gathered from public Metabolic and neurodevelopmental disease have been attracting attention as products safe for human use.

MO164 Evaluation of QSAR models for daphnia and fish chronic toxicities of human pharmaceuticals
T. Yamada, National Institute of Health Sciences; M. Kurinoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute of Environmental Studies; H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; N. Tatarazako, Ehime University / Faculty of Health and Environmental Sciences; T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; A. Hirose, National Institute of Health Sciences / Division of Risk Assessment

Recently, medical regulatory agencies require pharmaceutical companies to assess environmental impacts of new pharmaceutical products before marketing. Hence, it would be valuable to predict ecotoxicity of new pharmaceuticals at developmental stage where in vivo testing is not feasible. In this study, two QSAR programs with ECOSAR by USEPA and KATE by Ministry of Environment in Japan are available, both of which are built using dataset of mainly industrial chemicals. In this study, we evaluated applicability and predictivity of the QSAR models using external dataset of the chronic ecotoxicity of human pharmaceuticals. The chemical structures and toxicity data based on D. magna reproduction test (OECD TG211) and fish early-life stage toxicity test (OECD TG210) were gathered from public domain. In order to examine the applicable domain where more reliable prediction results can be obtained, the following criteria were defined in this study: (1) logP values of target substances are within the lowest and highest values of the category chemicals, (2) number of category members is 5 or more, and (3) correlation coefficients of the linear regressions are greater than 0.70. Since KATE equips models for acute toxicity only in both species, Acute-Chronic Ratio of 10 was applied to estimate NOEC values. Then, ratio of calculated NOEC and measured NOEC (CM) was determined. For ECOSAR daphnia model, 82 out of 126 pharmaceuticals satisfied the criteria. Of these, 44 pharmaceuticals had CM between 0.1 and 10, some of which were assigned to amides or aliphatic amines. 72 pharmaceuticals were focused on for fish chronic toxicity. Within 0.00 to 0.12 fish pharmacokinetics, 82% of which have pharmacological action to neurotransmitter receptors in human. For KATE daphnia model, 19 pharmaceuticals met the criteria. The CM values were between 0.1 to 10 for 15 substances, most of which belong to primary amines aliphatic/aromatic, amides or imides, or neutral organics. For fish chronic toxicity, only 11 and 21 out of 72 pharmaceuticals satisfied the criteria with little comprehensive assessment of e-cigarette emissions and toxicological studies. This work was supported by the Research on Regulatory Science of Pharmaceuticals and Medical Devices from Japan Agency for Medical Research and Development, AMED.

MO165 Optimization and Accessibility of the Eco-Domain and the Ecotoxicological Threshold of Concern (ecoTTC) tool
R.R. Otter, Middle Tennessee State University / Biology; M. Embury, ILSI; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; J. Brill, The Procter & Gamble Co. / Environmental Stewardship and Sustainability; H. Chang, FDA / Center for Tobacco Products; D. Chang, United States Environmental Protection Agency; D. Chapman, DuPont / Disinfectants and Specialty Chemicals; J. Clarke, Health; B. Farr, ILSI Health and Environmental Sciences Institute (HESI) / Health and Safety, Environmental Sciences Institute HESI; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-UNIT ELCVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P.W. Wilson, Sanofi U.S., Inc. / Health, Safety and Environment; and the ECOSAR and Kathon databases, which contain hundreds of pharmaceuticals and other ingredients, were accessed via a web-based query system that is integrated with the ecoTTC concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.

MO166 Using toxicokinetic and toxicodynamic modelling to predict effects of chronic toxicity on rodent growth based on in vitro assays
T.O. Martin, Environment Department, University of York / Environment Department; R. Ashauer, University of York / Environment; P. Thorbek, Syngenta / Environmenal Safety

According to 2011 figures, 80% of the animals used for testing procedures in the European Union are rodents and among these 22% are used in longer term repeated dose tests. Alternative methods to predict the effects of chronic toxicity in rodents can therefore make a significant contribution to the reduction, replacement and refinement (3Rs) of animal testing. Body weight is one of the many endpoints monitored throughout chronic toxicity tests. We aim to develop in silico models to extrapolate the effect of toxicant exposure, measured as an appropriate internal dose metric, on the growth of rodents. Initially, to develop toxicokinetic-toxicodynamic models will be used to predict the selected internal dose metric and its effect on growth over the duration of repeated dose toxicity studies. These models will be developed using data from regulatory toxicity testing of pesticides. Experiments will then be designed to assess the effects of known intracellular pesticide concentrations on cell population growth in vitro. Cell number can be converted to cell mass, after which it should be possible to model the effects of matching internal doses on growth over time, in vitro and in vivo. The weight normalised effect on growth (mass dose group / mass control at a given time point) can then be calculated at various points along the predicted in vitro growth curves. These predictions can then be compared to corresponding in vivo observations. The prediction ability of this extrapolation will be explored for 10 pesticides, which will provide a good indication of the reliability and repeatability of the methods. Should predictions prove to be consistently accurate, this will provide a fast and inexpensive in vitro screen for body weight effects in rodents. Initially this may be applied as an alternative to range finding studies which are not a regulatory requirement but are commonly carried out prior to regulatory testing. In the longer term this may form part of a suite of in vitro and in silico alternatives to in vivo chronic toxicity testing.

MO167 Screening of metabolic- and neurotoxicity of environmental chemicals using C. elegans and transgenic zebrafish models
Y. Lee, University of Seoul; H. Lee, University of Seoul / School of Environmental Engineering; N. Chatterjee, University of Seoul / Environmental Engineering; J. Choi, University of Seoul / School of Environmental Engineering

Metabolic and neurodevelopmental disease have been attracting attention as...
environmental disease. Epidemiological evidences show that the disease is associated with exposure to hazardous chemicals. However, causal relationship has not been clearly understood. In the present study, we aimed to elucidate the link between occurrence of metabolic or neuro disease and exposure of environmental chemicals. We first screened potential of environmental chemicals on the disease model organisms, C. elegans and Zebraﬁsh. To maximize the advantage of these model organisms, we have conducted a screening using C.elegans mutants; ogla-1(ok1207), ogt-1(ok1474), ngl-1(ok259), transgenic zebraﬁsh, Tg[T2Kins:nS85-mCherry] and Tg[elavl3:EGFP];kn. The highly conserved O-GlcNAc transferase; OG T and O-GlcNacase; OG A genes are related to type 2 diabetes and null mutations cause alterations in C. elegans carbohydrate and lipid metabolism. Neurolikin NLG-1 control synaptic function, which is conserved from nematodes to mammals to modulate synaptic plasticity and interact with degeneration-related disorders (ADHD). Tg[T2Kins:nS85-mCherry] ﬁsh express insulin nitroreductase(InSNT) mcherry fusion protein in the pancreatic β-cell and Tg[elavl3:EGFP];kn3 ﬁsh express GFP in most post-mitotic neurons. Various category of environmental chemicals, such as, heavy metals (i.e. arsenic, lead, cadmium), ED C's (i.e. Nonylphenol, Bisphenol-A-E,D,F) and biocides (i.e. Chloroperoxides, CMTIMT, PGIH), were screened using C. elegans reproduction assay and zebraﬁsh transgenic assay. The preliminary results showed CMTIMT and BPA reduced ﬂuorescence intensity of insulin gene in zebraﬁsh, suggesting possible involvement of these chemicals on metabolic pathways. In brief, our results suggest multi-model approach could complement the limitations of a stand-alone model organism and thus more accurately identify chemical hazard on human health. Therefore, the outcome of the current study could be utilized for efﬁcient chemical screening and better risk assessment of the chemicals. Acknowledgement: This work was supported by the Mid-career Researcher Program (2017R1A2B2002242) through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning.

MO168 In vitro effects of two pesticides on the motility and viability of bovine spermatozoa
I. Bulhosa, University of Aveiro / Biology department; M. Lopes, ICBAS-University of Porto / Department Veterinary Clinics; J. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro
The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the ingestion of contaminated feed. This experimental set up was designed to evaluate the reproduction of those animals. Actually, spermatozoa are extremely sensitive to slight variations in the organism. The interaction between chemicals and sperm may alter its mobility; velocity and/or viability depending on which cell structures are affected. This work aimed at assessing the toxicity of ecological relevant concentrations of copper sulfate and glyphosate on bovine spermatozoa. Commonly, different species have been investigated. For this purpose the classification and prediction ester ecotoxicity

MO170 Chemoavailability of Organic Electrophiles - A Nonanomial Approach to Identify Candidates for Reactive Toxicity
A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Organic electrophiles are important components within the exosomines of humans, ﬂora and fauna. Their toxicity toward aquatic organisms is driven by two molecular initiating events (MIE): the hydrophobicity-triggered disturbance of cellular membranes and the chemical reaction with nucleophilic targets (e.g. reactive oxygen and nitrogen species, proteins, peptides or the DNA. The toxicity enhancement Tc, which indicates the ratio of narcosis baseline (hydrophobic MIE) vs. experimental in vivo or in vitro bioassay toxicity, has been used as a measure for the reactive MIE for many years. However, very early studies already showed that Tc does not solely depend on reactivity, but also decreases with increasing hydrophobicity. This indicates that the relevant nucleophilic targets are located in aqueous compartments and that the hydrophobic and the reactive MIEs do not contribute independently to overall toxicity. In this communication, we employ our concept of chemoavailability1,2 to a set of 58 Michael acceptors, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on Tc. To this end, reactivity was quantiﬁed by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH) which results in hydrophobicity through the octanol/water partition coefﬁcient and toxicity through the 48-h-effect concentration yielding 50 % growth inhibition of Tetrahymena pyriformis. The results demonstrate that the decreasing Tc with increasing Kow is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemoavailability, as a trade-off between log Kow and log Koc, is shown as a promising non-atomic tool to assess how aquatic toxicity is predominantly driven by the hydrophobic or the reactive MIE, or by both MIEs working in parallel. The authors thank the EU-funded project OSIRIS (GOC-CT-2007-037017) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for ﬁnancial support. [1] Mulliner D, Schüürmann G 2013. Mol. Inf. 32: 98-107. [2] Böhme A, Lapoa A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [3] Boume A, Thaens D, Paschke Á, Schüürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO171 Local Electroﬁlicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward Tetrahymena pyriformis
D. Wendt, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Electrophilic compounds such as α,β-unsaturated carbonyls are valuable reagents in organic synthesis and commonly used as industrial intermediates and products. At the same time, their electrophilic reactivity may become critical in case of uptake into organisms because of the ubiquitous presence of nucleophilic sites in proteins, peptides, DNA and RNA. Therefore, assessment of reactivity and exposure to electrophiles is of high toxicological concern. Thus, identiﬁcation of toxicologically relevant compounds is desired. A step forward would be to predict – rather than measure – the electrophilic reactivity of compounds directly from molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on computational quantum chemical descriptors. The link between electrophilic reactivity and toxicity was investigated. For this purpose, their correlation with logarithmic reaction rate constants toward Glutathione (GSH) was analyzed. GSH is a small tripeptide which acts as a protector against electrophiles in the cytosol. The dataset of electrophilic chemicals contained 97 α,β-unsaturated esters, ketones and aldehydes. In the context of aquatic toxicity toward Tetrahymena pyriformis, reactive toxicity is assumed to be the primary mode of action of the aforementioned compounds classes. Therefore, the descriptive power of calculated and experimental GSH reaction rate constants was compared: both models perform equally well and yield root mean squared errors of about 0.4 log units in modeling the toxicity enhancement as deviation from narcosis level based on 48h-inhibition-growth concentrations.

MO172 Using mechanisms of toxic action to classify and predict ester ecotoxicity
P. Bicherg, P. Bauer, KREATIS, P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment
Even though esters are often used and released into the environment, little is known about their mechanisms of toxic action to aquatic organisms. Therefore, the main objective of this study was to develop a screening protocol for potential ester toxicity. The compounds used were a set of 25 ester standards, representing a broad range of different esters. The esters were chosen to cover a wide range of octanol/water partition coefficients, including a variety of different hydrophobicity classes. The main focus of the study was the toxicological impact of esters on aquatic organisms. Therefore, the main target species used were the freshwater teleosts, the fathead minnow (Pimephales promelas) and the guppy (Poecilia reticulata). In both species, a battery of ecotoxicological tests was applied to assess the effects of the esters on the test species. The most important endpoints were survival, growth and reproduction. In parallel to these endpoints, some toxicokinetic endpoints were determined to get more information about the fate of the esters in the test species. The results of these experiments showed that the esters had a toxic effect on the test species. However, the toxic effects were not related to a specific structure-activity relationship. Therefore, the next step was to develop a screening protocol for potential ester toxicity. The protocol was based on the concept of chemoavailability. In addition, some special endpoints were used to get more information about the mechanism of ester toxicity. The most important endpoint was the determination of the Michael acceptor constant (Kma) which is a measure of the reactivity of the esters. The results of the screening protocol were compared with the results of the ecotoxicological tests to get more information about the mechanism of ester toxicity. The results showed that the esters had a toxic effect on the test species. However, the toxic effects were not related to a specific structure-activity relationship. Therefore, the next step was to develop a screening protocol for potential ester toxicity. The protocol was based on the concept of chemoavailability. In addition, some special endpoints were used to get more information about the mechanism of ester toxicity. The most important endpoint was the determination of the Michael acceptor constant (Kma) which is a measure of the reactivity of the esters. The results of the screening protocol were compared with the results of the ecotoxicological tests to get more information about the mechanism of ester toxicity.
narcotic compounds for algae but not for fish or daphnids. For the animal species, the regressions for esters are not the same as for narcotic compounds. The most likely explanation for this difference is the balance between hydrolysis rate and the toxic action of the parent and the degradation products. That is why they are considered as pronarcotics. A toxicity to algae in line with a narcotic mode of action suggests that the enzyme responsible for hydrolysis found in fish and daphnids is absent, or that therefore hydrolytic activity of esters is negligible. The di-esters appear more toxic than mono-esters for fish and daphnids because they can produce two times more metabolite than mono-esters. The more reactive esters are usually un saturated, like allyl/vinyl esters and alpha,beta-unsaturated esters, whose double bond can be activated by the carbonyl group. For these compounds the substitution around the double bond plays a decisive role in effective reactivity. Thus, methacrylates which have an alkyl substituent in position alpha of the carbonyl are not more toxic than aliphatic esters for any of the three aquatic species. On the other hand, Acrylates clearly express excess toxicity and have to be considered as acting through yet another mechanism of action relating to a model dedicated to soft electrophiles. Rather than model the toxicity only according to structural analogy, a modelling approach is used to develop QSARs for esters based on three pillars: structure, mechanism and species metabolism.

MOI73 Nanosensor pulsed electric field incorporation technique to predict molecular mechanisms of teratogenicity and developmental toxicity on fish embryos
K. Arizono, Prefectural University of Kumamoto / Faculty of Env - Synthetic Biology; A. Yamaguchi, National Institute of Technology, Ariake College; M. K. Arizono, National Institute of Technology, Ariake College / Biological Engineering; H. Sato, University of Tohoku / Faculty of Agriculture; A. Sobrino, Universidad Autonoma Metropolitana Iztapalapa / Biological Sciences; L. M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A. M. Uchida, Ariake National College of Technology / Department of Chemical and Biological Engineering; H. Ishibashi, Ehime University / Faculty of Agriculture; S. Kono, National Institute of Technology, Ariake College; N. Tominaga, Ariake National College of Technology / Department of Chemical and Biological Engineering

We developed and applied the nanosensor pulsed electric field (nsPEF) treatment condition and assessed the teratogenicity and embryonic developmental toxicity by chemicals using fish embryos. Furthermore, we analyzed gene expression profiles in fish embryos using DNA microarray and performed pathway and network analyses to understand the molecular mechanisms of chemicals in teratogenicity and embryonic developmental toxicity. Our findings suggested that the nsPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MOI74 Moving 3D in vitro intestinal models forward: transcriptomic characterization of the RTgutGC cell line.
L.M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences

Intestinal derived cell lines are useful in vitro models which allow for focused investigation of the gut. Naive, non-pathogenic and humanized cell lines derived from the first immortalized intestinal cell line derived from the rainbow trout (RTgutGC) offered an opportunity to explore intestinal uptake without the need for the use of numerous animals. Recent work using numerous compounds has acknowledged its potential as a replacement tool for animal based laboratory studies, there is still a lot to be explored before its widespread incorporation as a potential animal replacement model. Over 84% of the sequences were mapped to sequenced of the RTgutGC cell line and assessed the teratogenicity and embryonic developmental toxicity in fish embryos using DNA microarray and performed pathway and network analyses to understand the molecular mechanisms of chemicals in teratogenicity and embryonic developmental toxicity. Our findings suggested that the nsPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MOI76 Biological effects of 3 metals on "D" larvae of Japanese oyster Crassostrea gigas
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; C. Caceres-Martinez, Universidad Autonoma de Baja California Sur / Marine Biology; T. Shiozaki, Universidad Autonoma Metropolitana Iztapalapa / Marine Biology; J. Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Marine Biology

The Japanese oyster is an introduced species from Asia, which is cultivated in the coastal systems of the Mexican Pacific. Due to the fact that in the last 10 years the populations have had problems in their survival, in this work the evaluation of 3 biomarkers was performed in "D" larvae of this species, exposed to the metals Cd, Cr, Pb and its mixture, because these xenobiotics, are in high concentrations in the sites where the oysters are grown. Bioassays (72 hrs) were conducted where the "D" larvae were exposed to each of the metals in different concentrations propotion: 1:1. With the obtained data, the LC50 was calculated and the evaluation of 3 biomarkers was measured in the surviving organisms: the degree of lipoperoxidation (Tbars: Buege & Aust. 1978), the activity of the AchE enzyme (Ellman et al., 1961) and genetic damage ( Comet Test: Singh et al., 1988). The toxicity of metals according to the calculated LC50 values was: (from most to least toxic) Pb > Cr > Cd. The most toxic metal attained to the LC50 was Pb. The Krusal-Wallis test indicated that there are significant differences in the degree of lipoperoxidation, inhibition of AchE activity and genetic damage between the exposed organisms and the control group. The metal with the highest oxidative activity was Chromium (32 ± 8.97 nmTbars mg-1). And the metal mixture: Cd + Pb (45 ± 11.89 nmTbars mg-1). In the evaluation of genotoxicity it was observed that Cadmium had the highest effect (91% cells with damage) and Lead the lowest (43%). Cadmium and the mixture of metals caused inhibition in the activity of AchE (56% 38% respectively). The results of this study show that the Cd, Cr and Pb metals in sublethal concentrations have deleterious effects on the "D" larvae of Crassostrea gigas.

MOI77 Toxicity effects caused by exposure to Dichlorvos in organisms of different trophic levels
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; L. M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment

Dichlorvos (DDVP) is an organophosphate insecticide considered by the EPA as highly toxic. Because there are few studies of the effects of DDVP in aquatic organisms The objective of this study was to evaluate the toxicity of Dichlorvos in organisms of different trophic levels Cladocerans: Daphnia magna, Daphnia exilis, Daphnia pulex and Sinothrixus minus. The ostracod Cypria sp. and fishes: juvenile Char (Chrysichthys jordani) and juvenile zebrafish (Danio rerio). In addition their sublethal effects were evaluated by means of assessment of four biomarkers (growth rate, O,N index, lipoxeropidation and inhibition of acetylcholinesterase enzyme). Acute bioassays were performed, the organisms were exposed to 6 pesticide concentrations to determine the LC50. Subsequently tests with duration of 15 days were made where the organisms were exposed to a sublethal concentration (LC10), for assessment of 4 biomarkers (growth rate, O,N index, lipid peroxidation and inhibition of acetylcholinesterase enzyme). The LC50 values obtained in the bioassays varied from 5.300 to 0.021 mg L-1. In the tests it was evident that the cladoceran Daphnia exilis was more sensitive to DDVP compared to...
to other species. The O:N index had values below 9 fact indicates that organisms were in a high degree of stress. Growth rates of intoxicated organisms were between 19 to 49% lower than those observed in the control groups. The average concentrations of Thars registered organisms varied from 2.5 to 25.6 M Thars mg⁻¹ and show a direct dose-response relationship, since when increasing the time of exposure to DDVP increased the degree of lipid peroxidation in the tissues. A decrease in AChE activity was observed in response to between 22 and 45% and fish from 22 to 35%. The results of this study indicate that the effects of the pesticide DDVP are likely irreversible in some species.

MO178 Characterising estrogenic activity of arctic char tissue extracts in two fish in vivo bioassays

Contaminants from anthropogenic activities find their way to the Arctic through long-range atmospheric transport, ocean currents and via transport by living organisms (migrating fish or seabirds). Although the levels of POPs in arctic fish are generally low, local hot-spots of contamination have been demonstrated in freshwater systems affected by seabird guano, such as Lake Ellasjøen at Bear Island (Norway). High concentrations of organic halogenated compounds have been measured in resident populations of Arctic char. Accumulation of dioxin-like compounds of up to 8 times higher than the lowest observed effect level for egg mortality in temperate salmonid fish raise concern that residential Arctic char might be at risk for adverse effects at the individual and population level. In this study the aim was to compare the toxic potency of pollutants in Arctic char from the contaminated Lake Ellasjøen with those from the less contaminated Lake Laksvatn at Bear Island. This was done by in situ sampling, extraction, and fractionation of liver tissues from the following compounds (PCBs & POPs were produced: F₁- nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F₂-polar pesticides and metabolites of POPs, and F₃- polar POPs (polychlorinated biphenyls and chlorinated hydrocarbons of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was developed and used together with the established method for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor, (ER)-mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogenic activity in response to the F₁ fraction, Vtg induction was observed in rainbow trout hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytotoxic effects than rainbow trout hepatocytes. F₁ and F₂ from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F₁ having largest effect. Chemical analysis was performed to identify potential contributors to the observed estrogenic activity. The project was funded by the Norwegian Research Council, project. No. 221373.

MO179 Ultrasound: A novel approach to non-lethally measure hepato-somatic index in sentinel fish for environmental monitoring programs
Anders A. Åkesson, University of Saskatchewan / Veterinary Biomedical Sciences; Y. Palage, IISD-Experimental Lakes Area; P. Borrett, University of Saskatchewan; L. Hrenchuk, IISD-Experimental Lakes Area; M. Murdoch, Stantec Consulting Inc; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences; N. van den Brink, Wageningen University / Dept of Toxicology.

The need for monitoring contaminants in Arctic fish species to study body condition, liver size (hepatosomatic index) and other biomarkers of environmental effects monitoring (EEM) program studies impacts of contaminants found their way to the Arctic through long-range atmospheric transport, ocean currents and by transport of living organisms (migrating fish or seabirds). The aim of this study was to compare the toxic potency of pollutants in Arctic char from the contaminated Lake Ellasjøen with those from the less contaminated Lake Laksvatn at Bear Island. This was done by in situ sampling, extraction, and fractionation of liver tissues from the following compounds (PCBs & POPs were produced: F₁- nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F₂-polar pesticides and metabolites of POPs, and F₃- polar POPs (polychlorinated biphenyls and chlorinated hydrocarbons of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was developed and used together with the established method for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor, (ER)-mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogenic activity in response to the F₁ fraction, Vtg induction was observed in rainbow trout hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytotoxic effects than rainbow trout hepatocytes. F₁ and F₂ from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F₁ having largest effect. Chemical analysis was performed to identify potential contributors to the observed estrogenic activity. The project was funded by the Norwegian Research Council, project. No. 221373.

MO180 Weight of evidence for fish acute toxicity: a Bayesian network modelling approach
J. Møg, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization.

Reduction of animal testing wherever possible is requested by EU Directive 2010/63/EU. Fish Embryo Toxicity (FET) testing can be an alternative to using juvenile fish in acute toxicity testing. However, FET data are currently not accepted as a replacement to juvenile fish acute toxicity data for regulatory purposes such as REACH, without sufficient weight of evidence (WoE). The development of a WoE approach for FET data has been recommended by the European Chemicals Agency to significantly reduce the number of animals required for hazard assessments of chemicals. We propose a Bayesian network (BN) modelling approach for quantifying the weight of evidence. BN is a probabilistic modelling methodology which is an increasingly used in ecological risk assessment as well as in environmental monitoring programs. Changes in protein expression of primary sea turtle cells exposed to heavy metals, organic chemicals, and pesticides, F₂ and F₃ from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F₁ having largest effect. Chemical analysis was performed to identify potential contributors to the observed estrogenic activity. The project was funded by the Norwegian Research Council, project. No. 221373.

MO181 Divergent immunomodulatory effects of cadmium between two marine immune cell models in vitro, macrophages and mast cells.
D.L. Pien, Wageningen University / Dept of Toxicology; H.L. van den Berg, N. van den Brink, Wageningen University / Dept of Toxicology.

Cadmium can induce toxic effects via different mechanisms, e.g. depletion of cellular antioxidants leading to increase of ROS levels and induction of apoptosis. Such effects have been addressed in different types of tissues and cells, including the immune system. However, these mechanisms of toxicity may have differential impacts upon physiological and immunological processes. Macrophages and mast cells are two types of innate immune cells that play a key role in the immune system but have different functions. Macrophages can produce pro-inflammatory cytokines and chemokines that can recruit other immune cells to the site of infection. Mast cells, on the other hand, can produce allergic mediators such as histamine and tryptase that can contribute to tissue damage and inflammation. The aim of this study was to compare the toxic potency of pollutants in Arctic char from the contaminated Lake Ellasjøen with those from the less contaminated Lake Laksvatn at Bear Island. This was done by in situ sampling, extraction, and fractionation of liver tissues from the following compounds (PCBs & POPs were produced: F₁- nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F₂-polar pesticides and metabolites of POPs, and F₃- polar POPs (polychlorinated biphenyls and chlorinated hydrocarbons of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was developed and used together with the established method for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor, (ER)-mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogenic activity in response to the F₁ fraction, Vtg induction was observed in rainbow trout hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytotoxic effects than rainbow trout hepatocytes. F₁ and F₂ from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F₁ having largest effect. Chemical analysis was performed to identify potential contributors to the observed estrogenic activity. The project was funded by the Norwegian Research Council, project. No. 221373.

MO182 Changes in protein expression of primary sea turtle cells exposed to contaminants indicate the potential for in vitro proteomics as a high throughput tool to support biomarker discovery.
S.I. Chausia, Griffith University / Smart Water Research Centre / Australian Rivers Institute; F.D. Leusch, Griffith University / Australian Rivers Institute; A. Nouwens, The University of Queensland / School of Chemistry and Molecular Biology; J. van de Merwe, Griffith University / Australian Rivers Institute.
The development of biomarkers of chemical exposure and effect in threatened wildlife is challenging because traditional methods for biomarker discovery that involve in vivo testing or destructive sampling cannot be utilized. These challenges have long since been acknowledged and the development of non-destructive methods for the detection of biomarkers in wildlife has been examined for many decades. However, despite these efforts, progress in this field has been slow and the development of new non-destructive biomarkers to assess the environmental quality benchmarks. Quantitative Structure Activity Relations (QSARs) have shown promise in providing information about the potential of pollutants to induce toxic effects in wildlife.

**MO183 Baseline vs. Reactive Toxicity toward the Nematode C. elegans as Alternative Bioassay**

M. Amposah-Offei, University of Duisburg-Essen; S. Saleem, E. Bütter, A. Bier, A. Paschke, UFZ. Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The nematode Caenorhabditis elegans is the first multicellular organism with a completely sequenced genome. Since more than 20 years, it has been employed as a model organism for assessing the environmental toxicity associated with sediments. More recent work indicates that this worm may have a toxicity-relevant metabolic capacity. This finding makes C. elegans attractive as an alternative bioassay for sensing the toxicological potency of compounds that become activated through biotransformation. A prominent example are organic pro-electrophiles that may be biotransformed to reactive toxics and then covalently adducted to proteins of the DNA. Despite the large amount of studies with C. elegans in human and environmental toxicology, characterization of the narcosis-level toxicity toward C. elegans was still lacking. The latter, however, would be useful for identifying reactive toxics through their toxicity enhancement (TD) over baseline narcosis. In the present communication, organic narcotics have been employed to calibrate a respective regression line with log Kow (octanol/water partition coefficient) as x- and log TD as y-values in order to predict the toxicological potency of pro-electrophiles. Financial support from the HELD-DAAD scholarship no. 91649208 for Sumaira Saleem is gratefully acknowledged. 1. Traunspurger W et al. 1997. Environ. Toxicol. Chem. 16: 245-250. 2. Leung MWK et al. 2013. The Worm Breeder’s Gazette 19: 28-29. 3. Tejeda-Benitez L & Olivero-Verbel J 2016. Rev. Environ. Contam. Toxicol. 237: 1-35. [4] Blasch U et al. 2012. Chem. Res. Toxicol. 25: 170-180. [5] Schramm F et al. 2011. Environ. Sci. Technol. 45: 5812-5819. [6] Böhme A et al. 2016. Chem. Res. Toxicol. 29: 952-962.

**MO184 Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Nonanalional Tool for Mimicking Phase I Metabolism**

I. Moldrucks, Helmholtz centre for environmental research - UFZ / Ecological chemistry; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; A. Becker, Leipzig University; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The electrophilicity of a chemical substance can have a significant impact on its toxicological profile, as this property determines the chemicals' ability to form adducts with electron rich sites of proteins, lipid components, DNA and RNA. In many cases, this type of adduct formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosays, which address this type of MIE, are used for the quantification of a test chemicals' reactivity towards typical biological targets, and have facilitated the development of e.g. models for the prediction of the aquatic excess toxicity or skin sensitization potential. Apart from chemicals that possess electrophilic substructures in their initial form, there are compounds that can become electrophilic only after abiotic or biotic oxidation. The reactive toxicity of these chemicals, also described as pro-electrophiles, is often difficult to characterize with simplified model systems like chemoassays or in vitro bioassays because these methods typically do not sufficiently include an activation step. Our presentation introduces a new tool, based on an Fe-loaded zeolite, that is able to mediate the transformation of pro-electrophilic phenol and dioxynbenzene derivatives: previous findings of electrophilic potential of exposure on a threatened wildlife taxon have been trapped by coincubation with the tripeptide WCG (tryptophan, cysteine, glycine) and analyzed using high performance liquid chromatography coupled to tandem mass spectrometry. Profiling of the obtained adduct patterns enable the identification of formed electrophiles, and provides new insights into the oxidation pathways causing the reactive toxicity of pro-electrophiles. The authors thank the EU-funded project OSIRIS (GOCE-CT 2007-50717) and the BMBF-funded project ProHapTox (FKZ 031A22A and 031A22B) for financial support. [1] Böhme A, Laqua A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [2] Mulliner D, Schüürmann G 2013. Mol. Inf. 32: 98-107. [3] Chipinda I, Ajibola RO, Morakinyo MK, Rwuona TB, Simoyi RH, Siegel PG 2010. Chem. Res. Toxicol. 23: 918-925. [4] Böhme A, Thaens D, Paschke A, Schüürmann G 2009. Chem. Res. Toxicol. 22: 742-750.

**MO185 Integrated assessment of aquatic ecotoxicity for regulatory purposes**

c. cappelli, IRCCS Istituto di Ricerche Farmacologiche Mario Negri; C. Toma, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environment Health Sciences; A. Manganaro, Kode srl; D. Gudaleta, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; J. Arning, German Environment Agency UBA; A. Biegel-Engler, German Environment Agency / UBA / Chemicals; E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

The REACH regulation requires the assessment of the CMR and PBT properties of the chemicals produced or imported in EU in amounts exceeding 10 t/a in order to protect the human health and the environment. The JANSU project aims at the development of a JAVA application to prioritize and assess the chemicals according to the PBT, CMR and endocrine disruption properties with uncertainties estimation. To assess the ecotoxicity part of the property, we developed six continuous QSAR models for acute and chronic aquatic endpoints for the main trophic levels: EC50 96th and NOEC 96th algae (Raphidocelis subcapitata), EC50 48h and NOEC 21d Daphnia magna, LC50 96h fish (Oryzias latipes) and NOEC fish (more fish species). We used gaselet and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R2 up to 0.96 on the training set and up to 0.78 on the validation set when the applicability domain is considered). We used the three new QSARs on chronic endpoints to perform the assessment of chemicals; we used the three new QSARs and the seven ones implemented in the VEGA platform (https://www.veghub.eu/) on acute endpoints for screening purposes (two QSARs for Daphnia magna, two generic QSARs for fish, three QSARs for specific fish species). The ecotoxicity workflow is divided in three parts: algae, Daphnia magna and fish. For each part and each endpoint, the workflow integrates the experimental values (if any), the QSAR predictions and their reliabilities. The experimental values have a higher reliability than the predictions. The reliability takes into account the intra- and interspecific variability, the most sensitive species and the applicability domain index of the predictions. The users can choose a consensus or a worst case approach. The experimental values and the predictions are compared to the regulatory thresholds to verify if the ecotoxicity criterion is fulfilled for each trophic level. The final assessment for ecotoxicity is based on the integration of the assessment of the trophic levels (the values and their reliabilities) and the number of trophic levels that fulfill the ecotoxicity criterion. The scheme will be applied to other categories of chemicals, such as the biocides inside the LIFEB COMBASE project. The authors thank the projects JANSU (contract Z 6 - 80 710/20 - 3716 65 4140) by Umweltbundesamt (UBA) and LIFEB COMBASE (LIFE15 ENV/ES/416) for the financial support.

**MO186 An integrated testing strategy to fill data gaps for environmental risk assessment of isooalcohols**

G.E. Bragin, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Sciences; B. Hedgett, ExxonMobil Biomedical Sciences, Inc.; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Science; B. Kelley, ExxonMobil Biomedical Sciences Inc / Environmental Toxicology & Chemistry Laboratory; M. Lampi, ExxonMobil Biomedical Sciences, Inc. / Environmental risk assessments require quality data to provide defensible environmental quality benchmarks. Quantitative Structure Activity Relationship (QSAR) endpoint estimates are often appropriate for alcohols with a very strong correlation to aquatic toxicity test data. However, QSAR estimates require comprehensive justification to demonstrate applicability, and still may not fully meet regulatory requirements, leading to extensive long-term toxicity testing. Here, limited, strategic environmental testing was used to support QSAR predictions, thereby reducing animal testing while still meeting regulatory requirements.
Aquatop toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoocat and isoucanadol. The study objective was to employ a testing program consisting of long-term fish (limit test), invertebrate and algal toxicity tests to demonstrate that QSR estimations accurately predict aquatic effects from long-term continuous exposure to these substances, further supporting the use of QSR models across a range of isolated models. The data demonstrate that the QSR model employed accurately characterized the hazard of iso-alcohol and is protected of these endpoints. Moreover, this combined information, by demonstrating a regular and predictable pattern of toxicity amongst these substances, further justifies read-across between substances for other endpoints (such as bioaccumulation) and supports efficient use of data for general purpose risk assessments.

MO187
Looking for an alternative to glyphosate-based herbicides
V. Lioussa, K. Eiser, S. Limbeck, D. Rünnler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Glyphosate-based herbicides are widely used in agriculture. When these products are initially introduced into the market they were not intended to affect only target species i.e. plants. However, over the past decades there is growing evidence on the toxicity and genotoxicity of glyphosate on non-target species. On 27th November 2017 the EU member states agreed on a five-year renewal period for the use of glyphosate based herbicides. However, in case glyphosate-based herbicides become prohibited eventually, the availability of alternative active substances will become an urgent need. Nonanoic acid (a.k.a. pelargonic acid) is a biological derived substance considered as an environmental friendly herbicide. Its toxicity to mammals is low and is also not expected to have adverse effects on non-target organisms. The aim of the present study was to compare the toxicity levels of glyphosate and a glyphosate based herbicide against pelargonic acid and a pelargonic acid-based herbicide on aquatic ecosystems using zebrafish as a model organism. In order to do so, we investigated the effect of both active substances and their formulations on the developmental stages of zebrafish embryos (OECD Guideline, Test No 236). The corresponding values of LC50 were calculated. The larvae that hatched from the acute toxicity tests were recorded in the observation chamber DanioVision and their swimming behavior was estimated in EthoVision software. The potential effect of the tested substances on the respiratory system of aquatic organisms was investigated in vitro by performing the Neutral Red Uptake assay on the trout-dervied gill cell line RTgill-W1. Results of our in vivo and in vitro tests indicate that pelargonic acid and its formulation are more toxic (acute toxicity) than glyphosate and its based-herbicide. Furthermore, the behavioral assay indicates a potential for a neurotoxic effect of pelargonic acid on zebrafish larvae. To our knowledge so far there are no available data for a neurotoxic signal effect of pelargonic acid on aquatic organisms. Hence, this outcome has to be further investigated. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO188
Chemassay Profiling of Salicylates to Assess Their Reactive Toxicity
A. Werner, Leipzig University; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Salicylates are widely used as fragrance additives or UV light absorbers in cosmetics and consumer care products, and thus can contribute to the human exposiion. Moreover, hospital waste and industrial effluents contamination in thyroid active substances is a further concern. To further investigate the effect of both active substances and their formulations on thyroid active molecule occurs by performing the Neutral Red Uptake assay on the trout-dervied gill cell line RTgill-W1. Results of our in vivo and in vitro tests indicate that pelargonic acid and its formulation are more toxic (acute toxicity) than glyphosate and its based-herbicide. Furthermore, the behavioral assay indicates a potential for a neurotoxic effect of pelargonic acid on zebrafish larvae. To our knowledge so far there are no available data for a neurotoxic signal effect of pelargonic acid on aquatic organisms. Hence, this outcome has to be further investigated. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO190
The Xenopus Embryonic Thyroid Signalling Assay (XTA) for assessment of eﬄuents contamination in thyroid active molecules
D. Du Pasquier, Watchfrog S.A.; S. Guerin, V. Rocher, SIAAP; J. Mougel, AQUIREIS; A. Tindall, G.F. Lemkine, Watchfrog S.A.
The Xenopus Embryonic Thyroid Signalling Assay (XTA) was designed as a scent-based assay to provide information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. The XTA provides a rapid (< 72h) way to measure the response of embryonic stage tadpoles to potential thyroid disrupting chemicals, allowing a efficient method for screening thyroid disruptors. XTA could provide an alternative to complex in vivo tests. It can be used for screening large number of molecules or testing environmental samples that couldn't be stored or sampled in large quantities. OECD is currently validating this in vivo assay, the final stage of validation has been completed in 2017 and it is expected that the XTA may be approved as an OECD Test Guideline by 2019. OCDE validation focus on using the XETA to test pure chemicals but this test could be particularly useful for the hazard assessment of eﬄuents. During the 12 past years we applied this assay to eﬄuents including municipal wastewater, treated sewage efﬂuents, hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defined by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect presents in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP eﬄuents showed 1) Daily variations of the thyroid effect in wastewater may be linked to eﬄuent contamination and rainwater. 2) When the eﬄuent still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroid effect 3) A minor part of the thyroid effect removal occurs during and decarboxylation process. The major removal of the thyroid active molecule occurs during the nitrification step of the water treatment.

MO191
Advances on locomotion detection of Daphnia magna, Artemia franciscana and Paramecia caudatum
F.M. Salzer, V. Lioussa, X. Monforte Vila, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Animal behavior is complex and multidimensional. Over the past decades researchers tried to qualify and quantify it, in order to understand and predict it. The advances in this field are so radical that they actually formed a new scientific domain called “computational ethology”. A major gap in this field is that most
studies focus on terrestrial and aerial species in comparison to aquatic organisms. A reason for this discrepancy is that compared to terrestrial species, additional technical challenges need to be overcome when studying aquatic species e.g. light refraction and reflection interferences at the air/water boundary, positioning of the light source and suitable body marking techniques. However, a deeper understanding of the movement patterns of small-sized aquatic invertebrates and planktonic organisms is urgently needed, and additional motion tracking behavior can be an overarching endpoint for a wide range of environmental challenges. Furthermore, changes in their locomotion could be used as an endpoint when studying neurotoxic effects. As a result, the aim of the present study was to improve the current tracking techniques of Daphnia magna, Artemia franciscana and Paramecium caudatum. In order to do so, custom-made, portable multi-well plates were developed. Therefore, the easy of fabrication and cost-efficient plates can be implemented on behavioral and ecotoxicological studies on small-sized aquatic invertebrates and planktonic organisms in any lab with an access to a tracking system. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO192 Validation of the in silico prediction tool for toxicity of Algae by pharmaceuticals in environment
A. Hirose, M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute for Environmental Studies; H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Research; N. Tatara, N. Tatarazako, Ehime University / Environmental Risk; T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; N. Kobayashi, Y. Ikarashi, T. Yamada, National Institute of Health Sciences
There are some concerns for environmental impacts of the pharmaceuticals due to the unintended environmental effects, which may be different from biological medicinal effects. Therefore, medical regulatory agencies require the assessment reports of environmental impacts by new drugs before marketing. It would be useful to predict the ecotoxicity of the new drug at the developmental stage, because the ecotoxicity studies are usually conducted at the final drug developmental stage just before submission. To validate the current in silico prediction tool, we evaluated the applicability for ecotoxicity prediction by the ECOSAR software, which is the most widely used in silico prediction of industrial chemicals. In the last year, we evaluated the prediction performance of Daphnia magna reproduction and of the fish chronic toxicity. In this study, we evaluated prediction performance of the acute and chronic toxicity for algae. We used the ecotoxicity test data sets of about 100 pharmaceuticals. The EC50 values for the acute toxicity and the CBV for the chronic toxicity were compared with the prediction values estimated by the ECOSAR. The percentages of the pharmaceuticals of which the predictive values are different in less than one digit from the actual measured values are 43% and 44% for acute and for chronic toxicity, respectively. Overall applicability of toxicity prediction for algae was similar to that of toxicity for Daphnia magna or fish. In the case of Daphnia magna or fish, some antibiotics, anti-cancer, central nervous system agents with lower LogPow were underestimated. However, there is little dependency of LogPow in the case of Algal toxicity. Most of chemicals with aliphatic amines had tendency to be underestimated. This difference may reflect on the difference of the mode of actions between Daphnia/fish and Algae. In order to improve the predictability of the in silico ecotoxicity QSAR tool, more researches on discovering the structure dependent toxicological profile of Algae would be needed. This work was supported by the Research on Regulatory Science of Pharmaceuticals and Medical Devices from Japan Agency for Medical Research and Development, AMED.

MO193 SeqAPASS to Evaluate Conservation of High-Throughput Screening Targets Across Broad Taxonomic Groups
Cell-based high-throughput screening (HTS) and computational technologies are being applied as tools for toxicity testing in the 21st century. The U.S. Environmental Protection Agency (EPA) embraced these technologies and created the ToxCast Program in 2007, which has served as a screening and prioritization tool for thousands of chemicals. The rapid and automated screening methods take advantage of hundreds of (primarily) mammalian-based HTS assays for identifying biological activity suggestive of potential toxic effects. The data can aid in identifying chemicals that are most likely to impact biological pathways that lead to adverse health effects. To realize the full potential of the ToxCast data for predicting adverse effects to both humans and wildlife, it is necessary to understand how broadly these data may plausibly be extrapolated across species. Therefore, the U.S. EPA Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was used to evaluate conservation of the 460 protein targets represented in the ToxCast assay suite. The SeqAPASS query sequence was selected based on the model organism used in the ToxCast assay (e.g., human, cattle, chimpanzee, guinea pig, rabbit, rat, mouse, pig, or sheep). Similarity of primary amino acid sequences and sequences from appropriate functional domains were compared across species to identify target sequences conserved across taxa. To demonstrate application of the SeqAPASS data for extrapolation of ToxCast targets, case studies were developed that focused on the extrapolation of targets being evaluated as part of the Endocrine Disruptor Screening Program, including the androgen receptor, enzymes involved in steroidogenesis, and proteins in the P450 cytochrome superfamily. The results of these studies demonstrate the utility of SeqAPASS for informing the extrapolation of HTS data and identification of model organisms likely to be suitable for follow-up or complementary in vivo toxicity tests. The contents of this abstract neither constitute nor reflect official U.S. EPA policy.

MO194 In silico site-directed mutagenesis informs species-specific predictions of chemical susceptibility derived from the Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool
J.A. Doering, US EPA / Mid Continent Ecology Division; S. Lee, ORISE/USEPA; K. Kristiansen, UIT The Arctic University of Norway; L. Everseth, The Arctic University of Norway; M.G. Barson, U.S. EPA / Gulf Ecology Division; I. Sylte, The Arctic University of Norway / Department of Medical Biology; C. LaLone, U.S. EPA / Mid Continent Ecology Division
The Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was developed to address needs for rapid, cost effective methods of species extrapolation of chemical susceptibility. Specifically, the SeqAPASS tool compares the primary sequence (Level 1), functional domain sequence (Level 2), or individual amino acid substitutions (Level 3) of the protein target of a chemical in a known sensitive species to sequences of other species and calculates sequence similarity metrics to predict potential cross-species chemical susceptibility. Level 3 analyses offer the greatest resolution for extrapolation of chemical susceptibility across specific species, but uncertainties into the role of specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made manual interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and ecdysone receptor (EcR) to investigate how specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in identities of key amino acids cause no change in chemical interaction with a protein if residues share the same side chain functional properties and have comparable molecular dimensions, while differences in side chain functional properties or molecular dimensions can reduce protein-chemical interaction. These findings were considered in the development of automated Level 3 analyses and enabling automatically generated species-specific predictions of chemical susceptibility. These predictions were confirmed to agree with Level 1 and 2 predictions of AChE and EcR for more than 90% of investigated species, but also identified dramatic species-specific differences in chemical susceptibility that align with results from standard toxicity tests. The consistency of automated predictions of susceptibility across Levels 1, 2 and 3 and agreement with results of standard toxicity tests provides a compelling line-of-evidence for use of SeqAPASS in regulatory decision making species-specific chemical susceptibility predictions across broad taxonomic groups applicable to addressing challenges in species extrapolation for human and ecological hazard assessment. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO195 Survival and Teratogenic Evaluation of 91 compounds with environmental impact.
S. Calzolari, ZeClinics
ZeClinics (www.zeclinics.com) is a biotech company interested in developing efficient and reliable zebrafish screening tests to predict compound toxicity. In the recent part of the 20th century, it became evident the need to define a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of end phenotypes, analysis procedure, etc. – that can be applied by all the zebrafish toxicity community (SOP like protocols) and, eventually, to become the base for applying towards regulatory approval for the standardized test. In this study, we have performed a Developmental Toxicity Test on the NTP 91 compound list. For each compound, a 20 zebrafish embryos experiment was conducted at key developmetnal stages (Level 3) of the protocol with different concentrations (log3 dose/response curve: 100µM, 33 µM, 10µM, 3.3 µM and 1 µM) for a single biological replicate. Experiments were performed in chorionated embryos from 3 hpf to 96 hpf. Endpoints were analysed at 24, 48 and 96 hpf. Quantified phenotypes include mortality rate and teratogenic endpoints such as body deformity, scoliosis, pigmentation, heart edema and motor behaviour. It is important to note that the majority of the provided compounds were already dissolved in DMSO at 10 mM. This fact limited the range of maximum concentrations tested, which might have impacted in a lower-than-expected correlation between zebrafish and human data. In fact, 40/91 compounds did not
show any toxic phenotype at the maximum evaluated concentration. On the other hand, 39 displayed mortality and teratogenic phenotypes. Among them, the most toxic compounds were Saytex CP-2000, 4,4′-hexafluorisopropylidene diphenol, 3-loxo-2-propyl n-butylcarbamate, diethylstilbestrol, hexachlorophene, methylmercury chloride, rotenone and tetraethylthiuram disulfide.

MO196

MPA - an alternative for the standard procedure of Ames Test
J. Rossetto Martins Zwarg, School of Technology, UNICAMP; D.A. Morales, State University of Campinas / Faculty of Technology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; G. Umbuzeiro, School of Technology, UNICAMP / LAEG

The Salomonella/microsome assay (Ames Test) is the most widely used mutagenicity test for evaluation of pure chemicals and environmental samples. There are several protocols available in the literature, including those that reduce the amount of sample needed for testing with liquid and agar media. There is a miniaturized version using liquid media called Microplate Fluctuation Protocol (MFP) that has been extensively used specially in Europe. It is has similar sensitivity with the standard Ames as well as other protocols and good performance in interlaboratory studies. However, the MFP has some disadvantages such as being difficult to apply with strains with low and high spontaneous mutation frequencies. Another miniaturized version of the Ames test is the microsuspension assay, which is 13 to 20 times more sensitive than the standard protocol. It is performed 5X concentrated bacteria and less sample and S9 mixture but still uses conventional petri dishes (90 x 15 mm). It has been extensively used for environmental samples testing, including in Effect Directed Analysis (EDA). The objective of this study was to miniaturize of the microsuspension Salmonella/microsome assay using agar microplates under the concept of the 3R principle. The conventional plates were replaced by plates with 12 micro wells. For validation of this miniaturization, we selected 13 known more or less potent mutagenic compounds. Six were tested only without metabolic activation (S9) and the other 7 were tested only with S9 using three Salmonella tester strains that were selected based on their different spontaneous revertion frequencies (low, medium and high). The miniaturization procedure conditions were made as similar as possible to the Micosuspension protocol, using the same testing design, metabolic activation, and data interpretation. Each test was conducted in parallel. MPA and Microsuspension protocols showed 100% agreement, qualitatively and quantitatively. MPA is less laborious, uses less sample, materials, and reagents reducing overall costs. The amount of sample required for testing is at least 20 times less in comparison with the standard Ames assay. We conclude that MPA is a promising tool and could be used in substitution of the standard Ames procedure especially in situations where sample quantity is a limitation such as impurities, drugs in development and environmental monitoring studies.

MO197

SETAC Animal Alternatives Interest Group
A. Lillicrap, NIVA Norwegian Institute for Water Research / Ecotoxicology

Bioavailability and realistic risk assessment of organic chemicals (P)

MO198

The necessity of OASIS bead and polyethersulfone membrane extraction for the Polar Organic Chemical Integrative Samplers (POCIS) calibration: a case study for alkylphenol monitoring in produced water
L. Silvani, Norwegian Geotechnical Institute; C. Riccardi, INAIL; E. Eek, Norwegian Geotechnical Institute; M.P. Papini, Università La Sapienza / Chemistry; N. Morin, Environmental and Food Laboratory of Vendee / Chemistry; g. cornelissen, Norwegian Geotechnical Institute; A.M. Oen, Norwegian Geotechnical Inst. / Environmental Technology; s.e. hale, Norwegian Geotechnical Institute

Produced water (PW) is one of the largest discharges from the oil and gas industry and includes formation and injected water. It contains several toxic compounds such as polycyclic aromatic hydrocarbons (PAHs), alkylphenols (APs), heavy metals, etc. PW is usually treated by biological methods. The samplers were deployed in parallel. MPA and Microsuspension extraction protocols showed 100% agreement, qualitatively and quantitatively. MPA is less laborious, uses less sample, materials, and reagents reducing overall costs. The amount of sample required for testing is at least 20 times less in comparison with the standard Ames assay. We conclude that MPA is a promising tool and could be used in substitution of the standard Ames procedure especially in situations where sample quantity is a limitation such as impurities, drugs in development and environmental monitoring studies.

MO199

In situ passive sampling methods to measure freely dissolved concentration of PAHs in contaminated soil: comparison with ex situ measurements and evaluation over one year
N. Bartolome, Agroscope Reckenholz-Tänikon Research Station ART / Environmental Analytics; J. Hilber, Agroscope / Environmental Analytics; R. Schulin, ETH Zurich / Department of Environmental System Science; P. Mayer, Technical University of Denmark / Department of Environmental Engineering; T. Bacheli, Agroscope ART / Environmental Analytics

Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments contaminated by hydrophobic organic contaminants (HOCs). Over the past decade, researchers have successfully developed various passive sampling (PS) methods to assess the freely dissolved concentrations of HOC in soil pore water or suspensions (COPW). The COPW play a key role for environmental fate and toxic effects of these compounds. Field conditions such as temperature, ionic strength or soil water content may influence the distribution of COPW and are accounted for in the calibrated in situ PS methods. We have been studying the potential use of PS methods for providing promising results to measure COPW in the pore water of sediments, there is still very little information on the suitability of these methods for their application to soils, particularly under unsaturated water conditions. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six different PAH contaminated field soils. The different PAHs were located in plexiglass tubes and permanently water-saturated, while the other three were located in grassland and thus not saturated. Low density polyethylene (LDPE) was used as PS method. The samplers were deployed in situ covering a depth of 20 cm below the soil surface. Concentrations were assessed at all sites after six, nine and twelve months of exposure. For comparison, soil samples from the same locations were also analyzed using a conventional ex situ soil suspension method. The main objectives of this study were (1) to compare the measurements obtained with the two sampling methods, (2) to assess the influence of soil water saturation of the measurements (unsaturated versus saturated), and (3) to determine the role of seasonal variation (temperature and precipitation variation) and exposure time on the results of the in situ PS method. To our knowledge, this is the first experiment where PS methods were used to determine PAH concentrations in the pore water of sediments under field conditions in situ and to study the impact of soil water saturation. This study will help to find out whether in situ PS methods in soils are a tool to be potentially included in risk assessment and legislation.

MO200

Bioaccumulation of native and spiked p.p′- DDE by Eisenia andrei in γ-sterilized and non-sterilized soils
L. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX

The fate of organic chemicals and their metabolites in soils is often investigated in model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. Presently, effects associated to γ-irradiation, spiking and dwelling of earthworms were studied in field conditions (sterilization after contamination) and freshly spiked (sterilization prior to contamination) soils for the case of 1,1-dichloro-2,2-bis(p-chlorophenyl) etylene (p,p′-DDE). Changes in its sorption and bioavailability were linked to the changes in soil organic matter (SOM) chemistry measured by Diffuse Reflectance Infrared Fourier Transform (DRIFT) spectroscopy. Qualitative interpretation of obtained DRIFT spectra revealed changes in SOM chemistry manifested in a reduction of bioaccumulation factors (BAFs) of native and spiked p,p′- DDE in sterile and non-sterile soils. We have measured SOM chemistry for BAF calculation. Despite the absence of quantitative effects of γ-irradiation on p,p′-DDE bioaccumulation, the uptake kinetics were shown to vary between

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non-sterile and sterile soils. Sterilization appeared to increase uptake rates and reduce the influence of p.g.-DDE-soil contact time on bioaccumulation. These effects might be attributed to the effects of γ-irradiation on SOM chemistry alone or in combination with earthworms. Following our findings, γ-irradiation can be recommended as a relatively non-destructive method that is not expected to significantly affect risk assessment of bioaccumulative chemicals. However, in mechanistic studies the possible side-effects brought about by γ-irradiation should be taken into consideration.

MO201 Dissipation in soil and bioavailability to earthworms of two fungicides: comparison of laboratory and field experiments

S. Alonso, G. Delarue, J. Amossé, School of Environment, Beijing Normal University / School of Environment; L. Ya, School of Environment, Beijing Normal University / School of Environment; L. Yang, R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; E. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism; T. Piskorski, Innovative Environmental Services IES Ltd / Plant Metabolism


The pesticide fate in soil is currently studied through laboratory experiments, using homogenized soil and controlled incubation conditions. However, the representativeness of such experiments is questionable regarding to field conditions, i.e., soil heterogeneity, vegetation cover and climatic variations. Upon the few studies performed simultaneously under field and laboratory, the pesticide persistence and/or sorption on soil were evaluated as different; thus bioavailability could also be different. This study aimed at comparing the dissipation and the bioavailability of dimoxystrobin and epoxiconazole (two fungicides used in the commercial formulation of Swing®Gold®) in a loamy soil and in earthworms under laboratory and field conditions. Field experiments were conducted in a meadow located in Versailles (France) on 100 m² plots. The field soil and earthworms were regularly sampled after the treatment, over one year (April to April). Laboratory experiments were performed by mixing the fungicide solution with surface soil issuing from the same field, and incubated in dark, at 15°C and constant humidity. In both cases, four replicates were performed using the recommended Swing®Gold® dose, extra doses adapted to observe ecotoxicological effects and controls. The dimoxystrobin and epoxiconazole concentrations in soil were determined by an exhaustive extraction method and, to evaluate their availability, with a mild method engaging hydroxypropyl-β-cyclodextrin. At the same time, the bioavailability of the two fungicides was evaluated by determining their concentrations in exposed earthworms Aporrectodea icterica and Aporrectodea caliginosa. All analyses were performed by UHPLC-MS/MS. Under field conditions and five days after pesticide application, only 10% to 45% of pesticide residues were measured in topsoil, with high heterogeneity between replicates. After one month, the concentrations in soil increased, probably due to a plant-soil transfer. By contrast, applied dose was observed at initial time under laboratory conditions. For later dates and in both cases, dissipation was observed. The available fraction showed homogeneous rates under field conditions, and highly heterogeneous rates under laboratory conditions. However, the ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

MO202 Experimental assessment of specific plant uptake factor of 1,2,4-triazole with different concentrations in wheat

R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; E. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism


Environmentally significant risk assessment decisions in EU for Plant Protection Products (PPP) regulation are based on information obtained from Environmental Fate models. Such models (e.g., FOCUS PEARL and PELMO) attempt to quantify the partition coefficients of neutral organic compounds between water and immobilised artificial membranes (IAM), liposomes (membrane lipid), triolein (storage lipids), and sediment. The development of the models was based on new experimental data, as determined by the authors. Possible sources of the required Abraham parameters are examined, compared and discussed. Particular attention is given to the environmental domain of the models. Acknowledgment: This study was financially supported by the European Union 7th Framework Programme SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

MO204 Influence of grain size on the bioavailability and bioaccumulation of sediment-associated cypermethrin to benthic invertebrates

H. Li, J. You, Jinan University / School of Environment

Sediment particle-size distribution is an important factor influencing the bioavailability and toxicity of hydrophobic organic contaminants (HOCs) in sediment. Cypermethrin, a pyrethroid, was used as an example in the current study to investigate the effect of particulate distribution on the sorption kinetics and bioaccumulation potential of sediment-associated HOCs. Bioaccumulation test with oligochaete Lumbriculus variegatus and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., <20 μm, 20-63 μm, 63-180 μm, 180-500 μm and >500 μm. The respective residual water contents were 2.12, 2.06, 1.74, 1.47, 2.86% and 0.31%. The results of sediment characterization showed that the material, composition, surface area and adsorption capacity were significant different among sediments with different particle size, and adsorption capacity increased with decreasing particle size. In addition, the desorption rates of cypermethrin measured by Tenax extraction decreased with decreasing particle size. This result supported the theory that HOCs are more strongly bound to fine particles than coarse sediment. The different desorption rates of cypermethrin in different particle-size sediments may influence the freely dissolved concentrations in sediment porewater, and subsequently bioaccumulation potential and toxicity.

MO205 Effect of suspended particle on polycyclic aromatic hydrocarbon (PAH) bioaccumulation by zebrafish (Danio rerio)

Y. Zhai, X. Xia, School of Environment, Beijing Normal University; X. Xiong, School of Environment, Beijing Normal University / School of Environment; L. Xia, x. guo, School of Environment, Beijing Normal University

The present study presents new models of this type for the prediction of equilibrium bioconcentration factors (BCF) and soil or sediment sorption coefficients, are predicted using approaches based on simple linear relationships with the octanol/water partition coefficient (Kow). Recently, more sophisticated prediction models have been developed and applied, including LFER approaches. Such approaches allow distinguishing between separate sorption and desorption kinetics. However, this requires data on distinct partitioning processes, which are rather scarce. For theoretical models without the need for additional experiments, the partition coefficients for these separate processes have to be estimated. While these coefficients basically could be roughly estimated from Kow, the more sophisticated LFER equations, as known Abraham models, are preferred for such predictions. The and the respective residual water contents were 2.12, 2.06, 1.74, 1.47, 2.86% and 0.31%. The results of sediment characterization showed that the material, composition, surface area and adsorption capacity were significant different among sediments with different particle size, and adsorption capacity increased with decreasing particle size. In addition, the desorption rates of cypermethrin measured by Tenax extraction decreased with decreasing particle size. This result supported the theory that HOCs are more strongly bound to fine particles than coarse sediment. The different desorption rates of cypermethrin in different particle-size sediments may influence the freely dissolved concentrations in sediment porewater, and subsequently bioaccumulation potential and toxicity.
process. Suspended particles promoted the uptake and elimination rate constants of PAHs to zebrafish body excluding head and digestive tracts. The uptake rate constants with 0.5 g/L-suspended particle were approximately twice that without suspended particles, and the body burden in zebrafish increased by 16.4% - 109.3% for pyrene and 21.8% - 490.4% for fluoranthene during the first 8-d exposure. The findings from this study indicate that PAHs on suspended particles are partly bioavailable to zebrafish and particle ingestion is an important route in PAH bioaccumulation. Therefore, it is important to consider the bioavailability of HOCs on suspended particles to improve ecological risk assessment.

MO206 Methods for Deriving Site-Specific Relative Bioavailability Factors from Agricultural Bioavailability Data B.H. Mazzoc, ARCADIS; N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; A.K. Meyer, United States Army Corps of Engineers / Huntsville Center The U.S. Department of Defense is responsible for the environmental restoration of properties that were formerly used for firearm training ranges. Remnants of spent shell casings and projectiles were determined to be a source of polycyclic aromatic hydrocarbons (PAHs) at these sites based on results from surface soil analyses and historical information demonstrating that shell casings were commonly prepared using coal tar pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone matrix of the shell fragments reduces the oral bioavailability of PAHs compared to that seen in animal studies using pure benzo(a)pyrene in soymilk added to diets. To test this hypothesis, soil samples were collected from two sites to provide a range of PAH concentrations. Female B6C3Fl mice were fed diets amended with soild soil extracts at a rate of 5% in the diet for fourteen days. For benzo(a)pyrene (BaP), the fraction of total dose excreted in the urine (FUE) was determined for the soil- and soil extract-amended treatment groups. The Relative Bioavailability Factor (RBAF) is the ratio of the FUE in animals treated with soil over the FUE in animals treated with soil extracts of soil. Because each soil sample was tested in four cages of mice (two for soil and two for soil extract), there are different ways of computing the RBAF of each soil and the grand RBAF for the site. Pairwise RBAFs can be determined and averaged, but the more robust way to determine a site-wide RBAF from multiple sample points is to determine a linear regression of the metabolite excretion rates versus daily dosing rates. The FUEs produced coefficients of determination (r^2) that were greater than 0.83 and typically greater than 0.95, showing that the rate of BaP metabolite excretion was directly proportional to the daily dose rate of BaP. RBAFs were determined using Monte Carlo simulations to calculate the 95% upper confidence limit on the ratio of the soil and soil extract FUEs. The site-wide RBAF was equal to 14% for BaP. Pairwise RBAFs will be compared to the RBAF resulting from the regression approach, and the regulatory precedent for the regression approach will be presented.

MO207 Acute determination of adsorption coefficients for low adsorbing compounds - from experiment to result evaluation T.J. Richter, BASF SE, Agrarzentrum Limburgerhof / APD; T. Richter, BASF SE Agrarzentrum Limburgerhof / Global Product Safety and Registration; K. Platz, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modeling; A. Imer, Eurofins Agroscience Services EcoChem GmbH; M. Traub, Eurofins Agroscience Services EcoChem GmbH / Environmental Fate The determination of adsorption coefficients is a critical key parameter for the assessment of the leaching properties of low adsorbing compounds’ through the vertical soil profile. In case of expected low adsorption of a chemical compound, several experimental preconditions need to be considered to enable accurate adsorption parameter determinations: (1) An initial soil/solution ratio of 1/1 and (2) the liquid phase needs to be removed as completely as possible from the soil phase upon completion of the equilibrium. An experimental approach was developed and optimized allowing the efficient separation of the soil and liquid phase by centrifugation through the soil itself and a filter/frit system. Determination of distribution coefficients is done based on the direct method, hence extraction and analysis of the soil phase as well. Apart from the optimized experimental approach the data evaluation is addressed. This includes the elimination of any apparent sources of experimental random errors e. g. by suitable outlier tests. Possible systematic errors have been addressed by the experimental design/data evaluation itself leading always to an underestimation of obtained adsorption parameters. The data evaluation includes the calculation of adsorption coefficients (e. g. Kf) and of p-values with p=Kf / (msoi/isolution); note: msoi/isolution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFSAG, 2017. Technical report on the outcome of the pesticides peer review meeting on the OECD 106 evaluators checklist”. If p>0.3, additional considerations are necessary, e. g. suitable statistical tests, in order to evaluate data quality and to demonstrate significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95% confidence intervals of Kf and Kfo from isotherms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating opportunities of that approach.

MO208 Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomomas sp. strain ADP L. Rolando, Instituto de Recursos Naturales y Agrobiología de Sevilla / Water Research Institute; A. Barra Caraccio, National Research Council / Water Research Institute; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquimica y Conservacion del Suelo Atrazine is a herbicide used to control grassy and broadleaf weeds in sugarcanes, wheat, conifers, sorghum and soybeans on corn crops. Although since 1992 in European Union countries it has been banned owing to its toxicological effects, it remains one of the most consumed worldwide pesticide with annual consumption of about 70,000–90,000 tons. Atrazine removal from the environment depends on abiotic (photolysis and hydrolysis) and above all biotic degradation. The latter can be significantly affected by the herbicide bioavailability. The behavioral reactions of bacteria are rarely included in the biological assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tactic response of the motile atrazine-mineralizing bacterium Pseudomonas sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tactic response was assessed by a chemical-in-capillarity method and an inverted capillary assay for the repellent reaction in association with microscopic observations. The swimming behaviour was evaluated by a computer motion analysis software (CellTrack). We observed attraction responses at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicite a negative tactic response at low concentrations. We also observed that the swimming patterns of Pseudomonas sp. strain ADP was defined by 28 days. The data was non-parametric, and it was analyzed using Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to p < 0.05. The results revealed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to population growth rate or complete population collapse in such invertebrates.

MO209 The influence of biochar on the toxic effects of imidacloprid to the lifecycle parameters of Eisenia fetida B. Kriwolos, University of the Free State / Zoology and Entomology; P.M. Leeto, P. Voua Oromo, University of the Free State / Department of Zoology and Entomology Imidacloprid is an organic active ingredient for various insecticides used to kill a number of biting and sucking insect pests. As a soil amendment, it can enhance sorption and reduce the bioavailability of organic toxicants. Earthworms are important soil promoters and provide various benefits to plants and they are too sensitive to various pollutants, thus they are relevant indicators of environmental change. The current study aimed to assess if biochar has the ability to decrease the effects of the toxicity of the agro-insecticide imidacloprid (IMID) to earthworms. Cocoons laid by earthworms that had never been in contact with any toxicant were exposed to biochar-amended and non-amended aqueous solutions of IMID for a period of 28 days. The data was non-parametric, and it was analyzed using Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to p < 0.05. The results revealed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.

MO210 Chlordecone elimination kinetics in ewes M. Saint-Hilaire, Université de Lorraine / UL / URAFPA INRA; A. Fournier, Université de Lorraine /UL. J. Thome, Université de Liège ULG / LEAE-CART; C. Adam, Université de Liège / LEAE-CART; J. Parinet, C. Adam, Université de Liège / LEAE-CART; J. Parinet, C. Adam, Université de Liège / LEAE-CART; J. Parinet, C. Adam, Université de Liège / LEAE-CART; J. Parinet, C. Adam, Université de Liège / LEAE-CART Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against a variety of pests in the Mediterranean area, as well as in Sub-Saharan Africa, Central America and is persistent in the soils (concentrations are above 1 mg/kg dry matter). Consequently, animals can be directly contaminated by involuntary soil ingestion. Previous studies showed a CLD absorption of 100% in goats and its metabolism in humans, gerbils and pigs. CLD is reduced into chlordeno (CLDHO). Then CLD and CLDHO can be conjugated. No data are available about CLD metabolism and elimination of CLD in ewes, species that are usually consumed in the French West Indies. The objective of this study was to characterize the CLD elimination in ewes (linearity of the toxicokinetic, half-life in serum, metabolism, excretion forms and excretion routes). Three groups of 5 ewes received an intravenous single dose of CLD (0.04, 0.12 mg/kg body weight (BW)). Blood, urine and feces samples were taken at defined times up to 84 days after CLD administration. CLD analysis in serum (analysis for each dose) was performed at the CAR (Belgium) and CLD and its metabolites were analyzed in urines and feces (for the 1 mg/kg BW dose) at ANSES (France). For 1 mg/kg BW, 0.2 mg/kg BW and 0.04 mg/kg BW the half-life was respectively of 28.5 ± 3.0 days, 24.0 ± 6.3 days and 27.7 ± 5.0 days. These three
values were not significantly different (P > 0.05). Thus, it was possible to conclude that CLD toxicokinetic of CLD in ewe is linear. In urines, CLD and conjugated CLDOH were quantified. By comparing the two way of CLD excretion, feces appears to be the principal route of CLD elimination. Almost 60% of the administered dose was found in feces and only 2% was found in urines. To conclude, the elimination of CLD in serum of ewe is dose-dependent with the dose. In consequence, the different results obtained on CLD fraction in interstitial water can be extrapolated for different levels of exposure in the range of 0–1 mg/kg BW. This study reveals the CLD metabolism in ewes which was never shown before. The principal route of CLD elimination is via the feces. These results clearly indicate the CLD elimination kinetic in ruminants and will help to decontaminate exposed animals in the French West Indies.

MO211 Development and validation of QuEChERS extraction methods with or without enzymatic pretreatment to analyze chlordane and its metabolites by HPLC-C/MS/MS in urine and feces of ewes

M. Saint-Hilaire, Université de Lorraine UL; URAFPA INRA; T. Bertin, C. Intahavong, G. Lavison-Rompard, T. Guérin, ANSES / Unité PBM; A. Foumier, Université de Lorraine UL; C. Feidt, G. Rychen, Université de Lorraine UL; URAFPA INRA; J. Parinet, ANSES / Unité PBM

Chlordane (CLD) is an organochlorine pesticide used from 1972 to 1993 in the French West Indies to fight against the banana black weevil. It is known to increase the risk of prostate cancer and affect development of the foetus and after birth. Nowadays, this pesticide is no longer used but, because of its high persistence, it still remains in soil. Consequently, farm animals can be contaminated by soil ingestion and this is key issue for French West Indies breeding. Thus, this work tends to collect data about the CLD elimination in ewe so as to propose a decontamination strategy. CLD is mainly eliminated in feces and low amounts of CLD can be found in urines. CLD can be metabolized into chlordecol (CLDOH) in human, pigs and gerbils livers. Then CLD and CLDOH can be conjugated by the glucuronyltransferase. In feces, CLDOH was found but no conjugated metabolites were present. In urines, no conjugated metabolites were found although the authors thought they would. Actually, no information about the CLD elimination in ewe is available. These findings results were based on a former extraction method developed in 1980 to analyze CLD and its metabolites in urines and feces. The extraction was performed by liquid-liquid extraction. Quantification of the conjugated metabolites was calculated by difference between a sample with and without enzymatic treatment. The analysis was then performed by gas chromatography hyphenated with mass spectrometry. In order to have an update and more sensitive method, a new development was carried out with this work. The extraction was based on the QuEChERS methodology which is more and more used in the pesticides field. As no conjugated standards were available an update enzymatic pretreatment was set up. The analysis method was performed by liquid chromatography with tandem mass spectrometry using isotopic dilution given a reliable method. The methods were then validated according to the French standard NF V03-110 and the European Union guidelines. At the outcome of the method development, we have a new validated method for CLD and its metabolite analysis. According to the literature, CLD and CLDOH were present in ewe feces. In urines, CLD and conjugated CLDOH were quantified. These results highlighted a better sensitivity of the new method and allow proving the CLD metabolism in ruminants which was never made before.

MO212 Organic Contaminants in High Mountain Areas: Where and When to find them??

O. Machate, Helmholtz centre for environmental research - UFZ / Plant and Environmental Science; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; D. Schmeller, Helmholtz Centre for Environmental Research UFZ / Conservation Biology; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis

Semivolatile organic contaminants (SOC) are well known to undergo atmospheric long-range transport and enrich in remote high mountain ecosystems. To predict the risk for high mountain ecosystems it is necessary to have knowledge of the present concentrations of these contaminants and their bioavailability. Because the chemical concentrations of SOCs differ vastly in magnitude and spatial distribution within these areas. Mentioned as important drivers of these variations are the change in precipitation and temperature with increasing altitude and the locally prevailing wind patterns. Despite this knowledge, the task to interpret the results gained within studies on the spatial distribution of organic contaminants within high mountain areas remains difficult. To aid future researches with their assessment this poster tries to condense the key information on fate and behavior of organic contaminants in high mountain areas. Therefore, fate determining variables will be named and the movement and bioavailability of organic contaminants throughout the seasons be described.

MO213 Pesticide occurrence in different apicultural matrices (honey bees, wax and pollen)

P. Calatayud-Vernich, M. Andrés Costa, Universitat de Valencia / Environmental and Food Safety Research Group; F. Calatalyud, E. Simó, Agrupación de Defensa Sanitaria Apícola (apíADS); Y. Pico, University of Valencia / Medicine Preventive Sprayed crops with pesticides are visited by honey bees during pollen and nectar collecting process. Pesticides are transported inside the hive, where both, agrochemicals from agriculture and compounds used in-hive against varroosis by beekeepers are accumulated in wax, pollen and honey bees. Samples of honey bees (45), wax (65) and pollen (45) were obtained from 45 different apiaries located in Spain. The samples were extracted by a slightly modified QuEChERS procedure depending on the matrix, and then screened for 58 pesticides and its degradation products by liquid chromatography mass spectrometry (LC-MS/MS). The target analytes were chosen based on their potential toxicity to honey bees and their widespread use in plant protection or in the beehive against varroa mite. Wax and pollen are the most commonly sampled matrices and exhibited a wide contamination by pyrethroids and organophosphates. Beeswax lipophilic nature and its lowest replacement rate in the hive are responsible of its highest pesticide content. Acaricides used in beekeeping such as coumaphos, chlorfenavinphos, amitraz and fluvalinate were the most frequently detected pesticides in wax. Some pesticides used in crops as organophosphate chlorpyrifos were detected in lower frequencies and concentrations. Pollen contamination pattern was similar to wax matrices. Acaricides applied in beekeeping were the most frequent and with the highest concentrations. Neonicotinoid acetamiprid and organophosphates chlorpyrifos and dimethoate were detected in pollen samples. Both insecticides are sprayed in crops and deposited on the pollen grains, which are transported to the hive during the foraging activity of the honey bees. Honey bee samples were less contaminated, although some acaricidal. This fraction was calculated in the product of the concentrations detected in the matrices analyzed, honey bee colonies health could be compromised. Assessing pesticides content in these three different apicultural matrices at the same time is a useful tool to understand the magnitude of honey colonies exposure to toxic compounds, which is one of the main causes of the progressive decline in honey bee colonies around the world.

MO214 Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.

N. Puchex, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

One of the main factor in the secondary poisoning risk assessment is the bioavailability of potentially hazardous organic chemicals, especially in the case of soil contaminated with persistent organic pollutants. In the context of the TROPHE project, the transfer of PCBs and PCDD/Fs to plants and invertebrates has been studied. BCF in several plants and in earthworm has been measured and different models have been used to calculate predicted concentrations. The comparison between the earthworm concentrations extrapolated from the Kow of the substance. It was also possible to illustrate the impact of these differences on the results of the secondary poisoning exposure modeled concentrations. A screening on the ECHA registration site also provides an approximation of the number of registered substances that have a BCF extrapolated from the model. This BCF, relatable to interstitial water, is not comparable with BCF measured with available guideline such as OECD 317 – Bioaccumulation in Terrestrial Oligochaetes, relatable to total concentration in soil. Data obtained in the context of the TROPHE project allow for the comparison between the measured BCF extrapolated from the OECD 317 guideline and BCF measured in earthworm extrapolated from the Kow of the substance.
MO216

Risk Associated with Alternative Cleaning Method for Carrot
P. Abara, Federal University of Technology Owerri / Department of Biological Sciences; L.A. Adjeroh, C.O. Ezea, Federal University of Technology Owerri / Biology; A.C. Udubeani, Federal University of Technology / Department of Biotechnology

ABSTRACT Risk Associated with Alternative Cleaning Method for Carrot

Introduction Carrot is a nutritional root vegetable which is loaded with beta carotene, a precursor of vitamin A. It is necessary to wash carrots in order to remove soil and other foreign materials before eating either raw or in processed form (Moos et al., 2002). It is common practice nowadays to soak carrot in detergent solution before washing to achieve better cleaning. Some components of detergent are toxic (HERA, 2013; Chuku et al., 2015). The aim of this study is to evaluate the detergent residue accumulated in carrot exposed to detergent. Methodology The first stage involved distribution of questionnaires to determine the popularity of the use of this chemical substance in washing carrot before selling to consumers. The second stage involved soaking 2 kg of fresh carrots in five increasing concentrations of Detergents 1 and Detergent 2. The carrots were soaked for 20, 40 and 60 minutes, after which they were grounded and analyzed using the titrimetric method described by IPAN (2005). Results a. 64.29% of the respondents agreed to the use of detergent in soaking before washing. 25.14% do not use detergent in washing their carrots before selling to consumers while 10.57% were indifferent. Anionic Surfactant Residue in Exposed Carrots There was a concentration and time dependent increase (P < 0.001) in the percentage anionic surfactant in the exposed carrots Figure 1: Anionic Surfactant present as Residue in Carrot Washed with Detergent. c. Percentage Cationic Surfactant Residue in Exposed Carrot The percentage cationic surfactants residue increased with concentration and length of exposure. Figure 2: Percentage Cationic Surfactant Residue in Exposed Carrot. Figure 29: Quantity of Detergent Residue in Exposed Carrot. Conclusion The presence of residual amount of detergent in the exposed carrot raises a public health concern as this food item is daily consumed by unsuspecting public.


Effect of washing carrot with Omo detergent on the nutrient composition, shelf life, associated fungi and health hazards. Pacesetter

MO220

B-Rice: bird focal species identification in rice paddy
A. Caffi, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; F. Marchetto, ICPS / Public Health; F. Galimberti, A. Riva, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; L. Bani, V. Orioii, Università degli Studi Milano Bicocca / Dipartimento di Scienze dell'Ambiente e della Terra; S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health

Pesticide registration in EU (Reg. 1107/2009 EC) requires appropriate risk assessment for non-target organisms including birds. The European Food Safety Authority developed a Guidance Document (GD) to conduct the risk assessment considering a series of exposure scenarios from a combination of crops and growth stages, selecting relevant species at the lower steps of a tiered approach. The actual GD doesn’t include scenarios for pesticide applications on rice; nowadays bird risk assessment is generally performed considering rice as the other cereals. Rice paddy is used as a refuge area by two cultivation sessions: the dry one, comparable to bare soil scenario (as common cereal), for which groups of species are equivalent to those identified for the actual risk assessment and already reported in GD; the flooded one, typical of aquatic environments and wetlands, representative of a unique exposure scenario not yet considered in the employed GD. The aim of this work is to characterize areas of rice growing in Northern Italy, which are representative for humid scenarios (via GIS approach), identify and link the relevant focal species to them. A review of the grey literature will be performed in order to estimate presence, abundance, dominance and diet of species associated to North of Italy rice paddies. Indicator and generic focal species will be proposed for the lower tiers of a Specific Rice Pesticide Risk Assessment and suggested as potential model for the Southern European Zone.
and limitations were discussed and adequately addressed by scientific communities, applicants and authorities. As a result, a variety of accepted tools are now available for exposure assessment. In contrast, population modelling approaches used in ERA for effect assessment in ecotoxicology are still at a relatively early establishment stage. In this respect, although effect modelling is recognised as a beneficial tool for adding ecological realism to ERAs, EFSA has so far not published any guidance document. Population modelling is at least mentioned in several EFSA (draft) guidelines and opinions as a refinement option. However, so far, outcomes of submitted effect modelling approaches in ERAs are not often considered by authorities. Many of the available models deal with protection goals that address field populations. Therefore, effect models are often stochastic and spatially explicit. This however makes these models more complex in comparison to the established deterministic exposure models and therefore considerable effort is needed for their verification, validation and comprehensive communication. Since effect modelling for ERA aims to predict effects on populations of the model organisms which arise from environmental exposure, we find it meaningful to use, in ecological models, the relevant data from the established fate models. This can make the modelling approaches more harmonised and probably would enhance their acceptability. We illustrated the usability of data on environmental conditions which agree with the established fate models and could as well demonstrate the implications of different environmental conditions on springtail populations. For this purpose, we used an individual based population model which represents the life-cycle of springtails in a temperature dependent framework. Specifically, we calculated soil temperature series with the groundwater model Pearl. Further, we used the constant in competitive fractions of leachate output after variable pre-equilibration times from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

MO223 Dynamic modelling of fluxes of weathered polychlorinated biphenyls (PCBs) in soil: column experiments vs. modelling approaches in realistic environmental conditions

C. Vitale, University of Insubria; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como, M. Morselli, A. Di Guardo, University of Insubria / Department of Science and High Technology

A column leaching experiment was performed to simulate realistic conditions that may be representative of different environmental scenarios and evaluate their influence on mobility and transport associated to dissolved organic carbon (DOC) and fine particles of aged polychlorinated biphenyls (PCBs) (PCB 28, 52, 101, 153, 138, 180, 209) in soil obtained from the Brescia-Caffaro contaminated site. The concentrations measured in leachates were compared to the results of simulations performed with a dynamic, air-litter-soil model (SoilPlus model) to investigate the predictive ability and the improvements needed to obtain better predictions. The variables taken into account were: 1) contact time between soil and water, 2) DOC content and quality in leaching solutions and in soil pore water, 3) fine particle-mediated transport, 4) temperature (and its influence on endogenous DOC production), 5) soil saturation conditions. These conditions were evaluated in five leaching fractions of leachate output after variable pre-equilibration times (2, 5, 7, 48 days), using leaching solution with different DOC content (tap water vs. a solution prepared with commercial humic acid), at different temperature (25 °C vs. 15 °C) and in saturated vs. pseudo field capacity conditions. Results indicated that equilibration time determined differences in measured PCB concentrations up to a factor of 8, probably due to the lack of equilibration with the environmental conditions in DOC extraction and recovery. The addition of endogenous DOC incremented mobility (up to a factor of 4) especially for brief contact time (non-equilibrium conditions) and within the Log Kow range 6-7.5. Samples leached at room temperature showed concentrations up to a factor of 9 higher in comparison to samples collected at lower temperature probably because of the different amount of endogenous DOC produced. Samples kept in pseudo field capacity conditions for seven days and then flushed resulted in about double the concentrations of the samples flushed in saturated conditions with a brief contact time, showing that drying-wetting cycles may determine concentration peaks. These trends were not caught by the model predictions as well as the relevance of the transport associated to fine particles, pushing for incorporation of this dynamic in models.

MO224 Assessing the trait-based ecological vulnerability of aquatic invertebrates for phenol

J. Park, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering; J. Kim, Gwangju Institute of Science and Technology; J. Kim, S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Recently, there has been considerable concern about the chemical accidents as usage and manufacture of phenol have increased. Phenol is harmful to living organisms and its exposure can cause ecological and economical damages. Therefore, it is necessary to prepare for possible chemical accident of phenol. The Korean government designated phenol as the accident preparedness substance and required to assess and manage the ecological risk of phenol. This study aimed to find the ecological risk at the scenario that phenol exposed to freshwater bodies in Korea. In particular, the vulnerability of aquatic invertebrates was explored to consider not only individual organisms also their populations. Vulnerability integrated the exposure, sensitivity, and recovery of the ecosystem by considering various traits (e.g., body length, food preference, toxicological sensitivity, recovery strategy, etc.). The traits were reviewed by published data or open sources, and respective scores were assigned by using multi-criteria analysis which transformed the numerical values. The toxicological sensitivity was derived by indirect prediction based on traits because of less data not postulated. The results figured out the vulnerable invertebrates for phenol in Korean freshwater. In addition, the vulnerable species showed that the consideration of only sensitive species would not be great ecological risk assessment and management. This work was supported by Korea Environmental Industry & Technology Institute (KETI) through "The Chemical Accident Prevention Technology Development Project", funded by Korea Ministry of Environment (MOE) (No. 2016001970001).

MO225 Assessing and managing food-web effects of Plant Protection Products

K. Swarowski, German Federal Environment Agency (UBA) / Department IV plant protection products; H. Hötker, Nature And Biodiversity Conservation Union (NABU) Germany / Michael-Otto-Institute; R. Oppermann, Institute for Agro-ecology and Biodiversity (IFAB); C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences; S. Matezki, German Environment Agency UBA; J. Wogrum, German Environment Agency UBA / Department IV plant protection products

Assessing impacts on biodiversity needs to integrate indirect effects ( trophic chain interactions, also referred as food-web effects or effects on biodiversity). Plant protection law requires protecting biodiversity and data requirements for Plant Protection Product (PPP) active substances (Regulation EC 283/2013) also acknowledge this aspect by mentioning indirect effects to be considered in the assessment of the impact of PPPs in addition to their direct effects. The results of PPPs have been well documented and recent scientific opinions of the European Food Safety Authority (EFSA) confirm the need for their inclusion in the environmental risk assessment of plant protection products. As a first step towards this direction, the currently renewed approval of glyphosate includes an obligation to the EU Member States to assess and manage the risk to diversity and abundance of non-target terrestrial arthropods and vertebrates via trophic interactions in the course of authorization procedures of glyphosate products. Therefore, we consider it necessary to develop an extension of the risk assessment to evaluate the indirect effects of specific PPPs in addition to the standard risk assessment and provide suggestions to risk managers on how to mitigate them. Due to the large variation in food web compositions and spatial and temporal implications, we do not consider it possible to achieve a representative and realistic estimate of indirect effects by means of mechanistic models. Instead, we suggest a simple empirical model to complement current risk assessment. However, implementing a risk assessment scheme for an additional subject of protection would not be feasible without offering solutions on how to manage the assessed risk. Otherwise, an adverse outcome of the assessment would inevitably lead to non-authorisations. To solve this conflict, we put forward an approach to manage risk by means of compensating food web effects. In practice, compensation is established by ecological compensation areas such as flowering margins, set-asides and beetle banks infilled. To make most out of existing types of suitable measures and to enable a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the individual measures with regard to their value for supporting in-field biodiversity (and thus to compensate for indirect effects of PPPs).

MO226 Compensating for ecological risks of pesticides

S. Matezki, K. Swarowski, German Environment Agency UBA; J. Wogrum, German Environment Agency UBA / Department IV plant protection products

Current environmental risk assessment (ERA) of pesticides overlooks a considerable part of existing risks and consequently fails to protect the environment from pesticide effects in toto. Examples of such blind spots are risks to field-dwelling species including wild pollinators, amphibians and farmland birds as well as indirect food web effects. In effects, we did not scientifically well described and highly relevant for the achievement of the legally defined environmental protection goals, eliminating these blind spots in the risk regulation has failed so far. The ‘indirect effect’-issue is an illustrative example for what we would actually regard as a crisis in environmental risks regulation of PPPs. What we recognize is that progress in ERA notably seems to be hampered for types of risk for which no effective risk assessment approaches have been established, so that an assessment of such risks would inevitably lead to non-authorizations. To solve this conflict, we wish to put forward a radically new approach in risk management: Compensating adverse effects of pesticides where established methods of risk mitigation fail to prevent them. Once implemented into the iterative process of risk assessment, such new risk mitigation approaches would allow to manage actual risks more adequately than currently possible, thereby preventing an increase of non-authorizations. It has not escaped our notice that our proposal could also make excessive higher tier assessments dispensable, thereby helping to solve the problem of the increase of complexity in ERA.
MO228
Historical control data of the optimized Zebrafish Embryo Development Toxicity Assay (ZEDETA)

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuizen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for this test. Therefore, a protocol based on the OECD guideline No. 236, has been developed and optimized by Charles River Laboratories Den Bosch, the Netherlands. Multiple studies were performed using the optimized protocol, which allowed for collection of historical control data on the frequency of malformations, mortality and development of the embryos/larvae exposed to the control treatment. In our protocol, embryos in the blastula phase (2-4 hours post fertilization (hpf)) were selected and exposed to adjusted ISO medium. Twenty four embryos (one embryo per well in a 24 wells plate), were exposed at a temperature of 26°C for a period of 96h. Exposure medium was renewed after 48 hours. Development were assessed daily using the Extended General Morphology Score (GMS). Teratogenic endpoints were scored as ‘present’ or ‘absent’ after 96 hours of exposure. The Extended GMS grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consisted of, but were not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf was 18. Teratogenic endpoints scored during the assessment comprise of malformations of sacculus/otoliths, head, heart, tail, yolk, pectoral fins and entire body. Data of twenty experiments were analysed. In total 400 embryos were exposed to control treatment (i.e. adjusted ISO medium). The average mortality rate in the control treatment was 2.5% which was considered acceptable. In only three experiments a maximum mortality of 10% was reached, which was still considered acceptable. Sixty percent of surviving larvae scored the maximum of 18 points for development, whereas 32% scored 17 points at the end of exposure (100 hpf). The most frequently observed findings were malformations of yolk (3.3%) tail (3.1%), heart (2.3%) and head (1.3%). These findings were observed in 6.4% of surviving larvae only. Analysis of the historical control data shows that the used optimized protocol produces an optimal development rate of exposed embryos and larvae, with minimal mortality and a minimal background malformation rate. This indicates a low level of confounding factors and high reliability of results produced with our protocol.

MO229
Optimization of the Zebrafish Embryo Developmental Toxicity Assay (ZEDTA)

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuizen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for the ZEDTA. The aim of this research was to optimize the protocol, i.e. examine which combination of exposure parameters is optimal for embryonic and larval development and is at the same time most cost-effective. An optimal embryo number should yield normal growth and development with minimal mortality and/or malformations. The OECD guideline No. 236 was used as base. In our protocol embryos in the blastula phase (2-4 hours post fertilization (hpf)) are exposed to adjusted ISO medium. The following factors and their combinations were investigated: temperature (26 vs. 28°C), exposure vessels (24 vs. 96 well plates), renewal periods (static (no renewal) vs. semi-static (24 or 48 h renewal)), and use of solvent (0.05% v/v DMSO vs. adjusted ISO medium). Development was scored daily, using the Extended General Morphology Score (GMS). This system grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consist of, but are not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf is 18. Teratogenic endpoints such as malformations of sacculus/otoliths, head, heart, tail, yolk, pectoral fins and entire body were scored as ‘present’ or ‘absent’ after 96 hours of exposure. Mean developmental and teratogenic scores were calculated and used to select the most optimal condition for each factor. Our experiments showed that exposure in 24-well plates at a temperature of 26°C in combination with renewal of exposure medium after 48 hours of exposure produced the most optimal results with the lowest incidence of malformations. Daily renewal of medium provided similar results, but this was less cost-effective. Use of 0.5% v/v DMSO did not induce more malformations or mortality than exposure to adjusted ISO medium.

MO230
Reliability of ecotoxicological studies in fish

H. Wünnemann, Bavarian Environment Agency; H. Ferling, Bavarian Environmental Agency; G. Dembek, W. Schmidt, W. Koerner, Bavarian Environmental Agency; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology

Final testing and evaluation in ecotoxicology valid bioassays are essential for deriving Environmental Quality Standard (EQS). The generally established biotests using the three trophic levels - algae, invertebrate and fish - according to OECD Guidelines provide in particular the baseline data for the derivation of the EQS. To obtain the most accurate EQS by use of a low assessment factor of 10 data from all three trophic levels including long-term results are required. Depending on the test substance growth inhibition of algae, immobilization of daphnia as well as deformation and death of fish embryos are not necessarily the most sensitive organisms and endpoints. Fish are in many cases the most suitable test organisms to demonstrate effects of e.g. pharmaceuticals with a specific mode of action in vertebrates. Therefore, prolonged toxicity tests with fish are of great importance. However, the study design has to be adapted to specific endpoints according to the pharmacodynamics of the tested drugs. Thus, in planning and implementing this type of study special care must be taken to ensure that the generated data can be used for derivation of EQS. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klimisch, Cred) up to date still numerous studies are available which do not fulfill these criteria and thus have to be excluded in the assessment process. Frequent failure sources include e.g. not statistically significant data, which is indicated by the number of concentrations tested, missing chemical analysis of test compound concentration in the test water, calculation of toxicological endpoints on the basis of nominal and not real concentrations, or insufficient quality of endpoints. The aim of the presentation is to outline, from our point of view, optimal experimental conditions of prolonged fish tests which can be adapted as a model for other scientific studies, thereby increasing the scientific results and considering so far neglected aspects such as possible background contamination of commercially available fish feed frequently used in fish studies.

MO231
Assessment of the relationship between heavy metal bioaccumulation and biomarker responses in Japanese dace inhabit in heavy metal contaminated river

H. Takeuchi, Toyo University / Research Center for Life and Environmental Sciences; Y. Iwasaki, National Institute of Advanced Industrial Science and Technology AIST Japan / Research Institute of Science for Safety and Sustainability; D. Kitamura, Toyo University / Graduate School of Life Sciences; Y. Kato, Toyo University / Faculty of Life Sciences; Y. Shimizu, Toyo University / Graduate School of Life Sciences; H. Tatsuta, University of the Ryukyus / Faculty of Agriculture; S. Kashiwada, Toyo University / Graduate School of Life Sciences The Watarase River, running in the northern Kanto region of Japan, had been severely polluted by heavy metals due to Ashio mining activities from late 1800s to early 1900s (e.g., 20 mg Cu/L in river water in 1897). Although the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still higher than those in a unpolluted river, the Omoi River. In previous study, our group investigated the heavy metal accumulation status (Cu, Zn, As, Pb, Cd and Fe) in organs of Japanese dace Tribolodon hakonensis captured from mid reach sites in the Watarase and Omoi River, and also analyzed those river water and sediment concentrations. Water and sediment concentrations of Cd, Pb and Zn in the Watarase River were generally higher than those in the Omoi River, interestingly, whereas Zn, As, Pb and Cd concentration in liver of Japanese dace in the Watarase River were lower than those in the Omoi River. Additionally, although there were no significant genetic differences between both riverine dace in microsatellite analysis, bile metallothionein (cysteine-rich protein involved in metal detoxification) concentration in dace in the Watarase River was significantly higher than that in the Omoi River. It suggests that the dace inhabit in the Watarase River may have been adapted to metal contamination by biological responses not depending on genetic characteristics. In the present study, for understanding biological response mechanism of dace to the metal contamination, we analyzed multiple biomarkers (such as erythrocyte δ-aminolevulinic acid dehydratase, blood protoporphyrin and hemoglobin concentration, and bile metallothionein concentration) in dace captured in the Watarase and Omoi River, as well as metal accumulation status of those fish. In this presentation, we will show detailed results, and discuss about the relationship between heavy metal bioaccumulation and biomarker responses in riverine fish inhabit in metal contaminated river.

MO232
Micronucleus test to evaluate effects of 4 metals on DNA damage of zebrafish

A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Lab. Limnology and geology; Department of Hydrobiology

Danio rerio is a species of importance since it is used as a test organism for ecotoxicological studies at the International level. In our country the tests widely used are only provided in medical research, for this reason...
Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants. The oxidative stress will be discussed comparing multiple pathways of exposure, and the severity of oxidative stress, this imbalance can lead to DNA damage in a variety of organisms. However, the subcellular antioxidant system of marine organisms. Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS) and the organism’s ability to detoxify reactive intermediates, such as those generated by metabolism of PAHs by cytochrome P450 (CYP1). Depending on the severity of oxidative stress, this imbalance can lead to DNA damage in a variety of ways, such as oxidized bases, apurinic/apyrimidinic sites (AP sites), single or double strand breaks and DNA adducts. Exposure to PAHs can lead to increased DNA damage, such as those created by AP sites (purine loss) and the formation of DNA adducts, in which PAH metabolites intercalate into the DNA. Total PAH concentrations were analyzed in exposure matrices, as well as fish livers and whole bodies to determine specific dosages. Multiple assessments have been carried out to examine oxidative stress, total antioxidation power analysis, 2-Thiobarbituric Acid Reactive Substances analysis, GSH/GSSG ratio determination, AP site quantitation, and 8-OHdG quantitation. Evidence of oxidative stress will be discussed comparing multiple pathways of exposure, and resulting impacts in terms of biological and ecological implications.

MO235 Impact of PAH/oxy-PAH mixtures on heart development in zebrafish V. Cunha, K. Dreij, Karolinska Institutet Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have been widely studied. Oxygenated PAHs (oxy-PAHs) are also found in the environment and are emitted from the same primary sources as PAHs but also can be formed through secondary oxidation of PAHs. However, relatively little is known about their environmental fate and toxicity. The aim of this work was to determine the effects of binary PAH/oxy-PAH mixtures on cardiac development in zebrafish (Danio rerio) embryos (2ZFs). ZFs (24 hpf) were exposed to a dose range of single PAH (benzo[a]pyrene, BP), oxy-PAH (the ketones 4H-cyclopenta[a]phenanthrene-4-one (4H-CPO), benzo[a]fluoranthene (BFO) and 6H-benzo[c]pyrene-6-one (6H-BPO)) or their binary mixture for 4 days. After exposure, ZFs were observed for effects on heart development, heart rate and blood flow. Samples were also collected for gene expression analysis. The results showed abnormal cardiac development, such as formation of string hearts where exposed to 6H-BPO and BFO in combination with BP were more potent than single exposures. The heart rate and blood flow was significantly decreased, in a dose-dependent manner, in ZEs exposed to 6H-BPO alone and in combination with BP. With the other oxy-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFO and 4H-CPO in mixture with BP. Gene expression analysis showed significant up-regulation of genes related to oxidative stress and inflammation, while oxy-PAHs showed up-regulation of genes involved in cardiac development (tnf5), especially for ZF exposed to the combination of oxy-PAHs with BP. Notably, the up-regulation of these two genes correlated with the formation of string heart. In summary, the binary mixtures were more potent than oxy-PAHs alone in inducing cardotoxicity, except in the case of 6H-BPO which seems to be a very potent oxy-PAH. The oxy-PAHs and PAHs interact and thereby increase the adverse effects of oxy-PAHs. The in vitro evaluation is the premise of the current study showed that exposure to low level BPS and BPSIP could affect the LMP (Maximum Permissible Limits) that marks the NOM 001 Semarnat for water discharges to natural systems, so it is possible that they can be used as biosensors in the studies of environmental monitoring.
includes detoxification enzymes induction (CYP1A), hemorrhaging, cardiovascular defects, pericardial and yolk sac edemas, craniofacial deformities or growth attenuation. The cardiovascular tissue is one of the most sensitive to PAHs, and all the aforementioned symptoms are caused by the activation of the aryl hydrocarbon receptor (AhR). However, the mechanisms involved downstream of the AhR activation by PAHs are still unclear. Some weak AhR agonists such as phenols can also produce cardiovascular effects (e.g. arrhythmia) via unknown AhR-independent mechanisms. In this study, we aimed to explore the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhynchus mykiss) ELS by the use of an integrated OMICS approach, i.e. the combined use of transcriptomics, proteomics and metabolomics. The use of OMICS can lead to evidence of which pathways are altered by PAHs, and thus help choosing candidate genes or proteins involved in the mechanism of toxicity. Newly injected rainbow trout larvae were exposed to three different PAHs (retene, pyrene or phenanthrene) at sublethal doses. The heart of each larva was sampled after 1, 3, 7 or 14 days of semi-static exposure, and RNA, proteins and metabolites were extracted. Morphometric parameters such as larval length and yolk sac area were also monitored, but were barely affected by PAHs. Preliminary data from transcriptomics and metabolomics showed different signatures of gene expression alteration as well as different metabolite profiles between treatments, suggesting specific mechanisms of toxicity. Overall, all compounds induced more changes in cardiac gene expression during the very first days of development, with the exception of pyrene which was also very potent after 7 days. Preliminary enrichment analysis (over-representation analysis) revealed that differentially expressed genes were likewise with differentially expressed proteins. Exposure to phenanthrene P450, cation transport, muscular contraction or steroid hormone biosynthesis in the case of retene. Some of those processes were shared by pyrene. Phenanthrene appeared to alter collagen biosynthesis, as well as the glutamate release cycle, but only at one sampling point and with very few genes involved. Proteomic analyses are underway to further highlight the mechanisms of toxicity.

MO238 Developmental Toxicity of a Non-steroidal Anti-inflammatory Drug (Acetaminophen), in African Catfish (Clarias gariepinus) embryos. L. I Ezemanye, University Benin / Animal and Environmental Biology; N.O. Ezemanye, University of Benin, Benin City, Nigeria / Animal and Environmental Biology; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,University of Benin, Nigeria; P. Adebayo, University of Benin / Animal and Environmental Biology

The study investigated the developmental toxicity of Acetaminophen, a non-steroidal Anti-inflammatory Drug on the early life stage (0 to 96 hpf) of African Catfish (Clarias gariepinus). The 96 hrs fish embryo acute toxicity (FET) test was carried out according to the modified OECD 236 guidelines. Newly fertilized embryos were exposed to different concentrations (0, 0.5, 1, 5 and 10 μL/L) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural alterations were observable in treated groups. Exposure to acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisonous symptoms were recorded at higher dose. Exposed embryos were observed to have poorly formed somite’s, coagulated embryos, non-detached tail, altered spontaneous movement and inhibited swimming performance. Observed physiological alterations include cardiac edema, sac yolk edema, pericardial edema, tail malformation and lordosis. The result demonstrated that acetaminophen has the potential to alter the development of the early life stage of the African catfish.

MO239 In vitro approach for the identification of early warning biomarkers, related to exposure to PBDEs, in human and marine systems: oxidative stress, toxicity and cell cycle modulation C. Espinosa, S. Manuguerra, M. Morghese, UniPa / DiSTeM; A. Cuesta, M. L. Ezemonye

(1) in vitro, (2) ecotoxicological and biochemical analyses, in order to identify biomarkers for early warning, in relation to exposure to selected contaminants. The first experiments were carried on PBDEs, a class of brominated compounds extensively used as flame retardants, that are ubiquitous, toxic and persistent in the environments and for which the molecular mechanism, responsible of cytotoxicity remain unclear. Human and fish cell lines were exposed to different doses of PBDEs until 72 hours. After these experiments, sub-lethal doses were chosen for long term treatments. Expression of genes related to cell cycle, stress, biotransformation, apoptosis and oxidative stress, were analyzed by enzymatic assay, spectrophotofluorimetry, immunoblotting and real time PCR. The preliminary results revealed that fish cell lines are more sensitive to the PBDE than human cells. A condition of oxidative stress was observed by the presence of reactive oxygen species (ROS) and relative modulation of scavenger molecules/enzymes, seems to be the crucial event, influencing the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible of cancer promotion. Acknowledgements: the project CISA “Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana” (CUP B62F15001070005) is funded by CIPE- MIUR.

MO240 In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhynchus mykiss) proteins. D. Dehel Esposti, Iristea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Iristea / UniPa / DiSTeM; C. Espinosa, S. Manuguerra, M. Morghese, UniPa / DiSTeM; A. Cuesta, M. L. Ezemonye

MO241 Impact of metformin on zebrafish (Danio rerio) embryos S. Miezek, University of Heidelberg / Aquatic Ecology and Toxicology; T. Braunbeck, University of Heidelberg / Centre for Organisal Studies

The biguanide metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its antihyperglycemic effect, metformin is one of the most abundantly prescribed medical treatments for the diabetes mellitus type II. At the same time, metformin is also used as therapy agent for women with polycystic ovary syndrome (PCOS), a reproductive abnormality disease, and is being screened as a potential anti-cancer drug. Therefore, just in Germany, metformin usage has almost tripled in the last 10 years to 1.100 tons (2010) and it is still increasing. As a consequence of the high consumption, the pharmaceutical is detectable at relatively high concentrations in both waste water treatment plant effluents and surface waters around the world, even though most of the substance gets removed during conventional active sludge treatment. Since most of its active form (up to 100%) gets excreted through urine and faeces, the poor metabolism rates of metformin in humans add to this outcome. As a consequence, metformin poses a potential risk for aquatic organisms and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (CH3,NH3+xHCl) according to OECD test guideline 236 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. ‘n

MO242 Pyrrogallol and its structurally related compounds on animal cytochrome c oxidative activity Y. Kim, K. Kim, H. Jeon, H. Kim, Y. Choi, S. Lee, Kyungpook National University

Pyrogallol is a benzenetriol being a brownish solid, and is used for hair dyes after hair gels has demonstrated that there was no 2 fold increase in reversion relative to the controls. However, it still needs to be determined its safety to the living organisms, when it is introduced to the environment. In this study, we evaluated its inhibitory effect on cytochrome c oxidative (COX) activity,
which is vital for energy production and is located in mitochondrial membranes. COX activities from zebrafish (Danio rerio), Corydoras (Corydoras aeneus), earthworms (Eisenia fetida), and the lesser rice weevil (Sitophilus oryzae) were placed to be inhibited by pyrogallol and its related chemicals such as gallic acid, 1,2,4-benzenetriol, pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid. For the inhibition of zebrafish COX, pyrogalol was the strongest chemical among the tested chemicals with an IC50 of 0.66 μM. Taking together, benzenetriols including pyrogallol may be caused by unexpected inhibitory effects on the animal COX activity, referring fluctuation of the energy production, and the benzenetriol moiety is essential for the inhibition on the COX activity.

**MO243** Exposure to environmental concentrations of Triclosan induces oxidative stress and genotoxicity on zebrafish (Danio rerio) embryos

C. Parenti, A. Ghilardi, M. Mandelli, University of Milan; C. Della Torre, State University of Milan / Biosciences; S. Magni, University of Milan / Department of Biosciences; L. Del Giacco, University of Milan; A. Binelli, University of Milan / Department of Biosciences;

Triclosan (TCS, 5-chloro-2,4-dichlorophenyo) phenol is the most common antibacterial agent used in personal care products, including soaps, body lotions, laundry detergents, toothpastes and deodorants. For its properties it is also added to several household items such as food packaging materials, toys and textiles. Since TCS is not completely removed by WasteWater Treatment Plants (WWTPs), it is becoming a potential worldwide pollutant and it is frequently detected in surface waters, with concentrations ranging from ng/L to µg/L. These evidences that TCS is acutely and chronically toxic to aquatic organisms and it was already demonstrated that this chemical severely affects both zebrafish adult and embryos, causing embryotoxicity, hatching delay and biomarker alterations. Thus, the European Union (EU) has disapproved in 2016 the use of TCS in biocidal products, due to its unacceptable environmental risk. Meanwhile, consumer antiseptic wash products containing TCS can no longer be marketed in US. The aim of this study was to investigate the adverse effects of TCS at environmental concentrations on zebrafish embryos up to 120 hours post-fertilization (hpf). It is the first time that environmental levels of this contaminant were taken into account, instead of evaluating the effects of sub-lethal or lethal concentrations. The experimental plan consisted in the exposure to two different environmental concentrations of TCS (0.1 and 1 µg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPx) and glutathione transferase (GST) were measured, while the genetic damage was evaluated as the occurrence of the micronucleated cells (MN test). Results show a significant increase in all biomarkers measured, indicating that this chemical is dangerous for aquatic species also at environmental concentrations.

**MO244** Comparative study of acute toxicity of a Microcystis aeruginosa bloom containing microcystin-LR on common carp Cyprinus carpio and Wistar rat

Z. Hadjer, R. Bordj, H. Nasri, University of El Tarf, Algeria.; N. Bouaich, UNIVERSITY PARIS

Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria in water bodies throughout the world. Their mechanism of toxicity consists of a potent inhibition of protein phosphatases 1 and 2A, which causes disruption of the cytoskeleton and consequent cell death. They can also alter the antioxidant system and induce oxidative stress in various organs of many species. Microcystin-LR (MC-LR) is the most studied variant due to its high toxicity and frequent occurrence in surface waters. In this study, we used a Microcystis aeruginosa bloom extract containing mainly the microcystin-LR congener due to its high toxicity and frequent occurrence in surface waters. The occurrence of harmful cyanobacterial blooms in surface waters is often associated by a production of variety of cyanotoxins that represent a hazard for human and animal health. Microcystins (MCs) are the most common cyanotoxins and may be expected wherever blooms of cyanobacteria occur in surface waters with more than 100 variants have been characterized. Among these cyanotoxins, microcystin-LR (MC-LR) is the most studied congener due to its high toxicity and frequent occurrence in surface waters. The purpose of the present study was to investigate the effects of 12-week gavage of a Microcystis aeruginosa bloom containing mainly the congener MC-LR (>+95%), in male and female of juvenile (200 g) common carp (Cyprinus carpio). The fishes were been randomly assigned to three groups. Group I, is the control group, received daily physiological serum (500 µL) containing 2 and 10 µg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated. The effects of MC-LR on the two sublethal doses of MC-LR on the common carp Cyprinus carpio and Wistar rat

R. Bordj, Z. Hadjer, H. Nasri, Laboratory of Biodiversity and Environmental Pollution, University of El Taraf, Algeria.; N. Bouaich, UNIVERSITE PARIS

Dilbit differs greatly in chemical composition compared to conventional crude oils and the impact of dilbit exposure on aquatic organisms has not been well characterized, despite its widespread transport across North America. In this study, the effects of developmental exposures on breeding success and next generation embryos were compared between dilbit and two conventional crude oils (mixed sweet blend and medium sour composite). Zebrafish embryos were exposed to water accommodated fractions of these oils from 0-7 days post fertilization (dpf) and gene expression and DNA methylation were measured at 7dpf. Exposed embryos were then grown to adulthood in clean water. These fish were bred and their embryos were collected and reared in clean water (unexposed second-generation embryos). Breeding success of the first-generation developmentally exposed fish was determined by measuring the number of pairs that spawned, number of eggs spawned, fertilization rate, and survival of unsexed offspring. Gene expression and DNA methylation were also measured in 7dpf offspring. Developmental exposure in the first generation did not affect the survival of embryos and also did not affect breeding success when compared to control, but differed among exposure groups. Some target genes were differentially expressed in the developmentally exposed second-generation embryos when compared to control, indicating a heritable change in basal gene expression. This change in gene expression could potentially be due to changes in DNA methylation caused by the developmental exposure in the first-generation. Understanding what changes in DNA methylation mean for fish survival will require further study. Overall, it appears that developmental exposures to crude oil and dilbit have variable effects on first- and second-generation zebrafish embryos. Though second-generation endpoints are often overlooked, they are important to consider when evaluating the overall risk of oil exposure.
MO248  
Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights
A. Zenker, University of Appl. Sc. Northwestern Switzerland / Institute of Environmental Chemistry; N. Munz, University of Applied Sciences and Arts Northwestern Switzerland

The herbicide glyphosate and the pharmaceutical lisinopril are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of lisinopril, are largely unknown. The objective of the study was to find early detection markers by comparing in vivo effects and gene expression patterns in the fish embryo acute toxicity (FET) test and early-life stage toxicity test (ELS). Per substance 480 individuals of zebrafish were exposed to five different concentrations (lisinopril: 0.03 – 0.5 mg/L; glyphosate: 0.006 – 0.1 mg/L) and analysed for different morphological endpoints such as spontaneous movements, heart rate, hatching success and malformed individuals. Gene expression patterns of such inhibition for fish ability to detoxify xenobiotics remain to be elucidated. Keywords: rainbow trout, cytochromes, EROD, COH Acknowledgement - The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic, projects CENAKVA (No. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15082S) and Swedish University of Agricultural Sciences.

MO249  
New insights on cross-species differences in the modulation of human and zebrafish nuclear receptors by single chemicals and environmental mixtures
N. Creuset, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; C. Garioche, INERIS; A. Boulahtouf, INSERM / IRCM – U1194; F. Brion, INERIS / Ecotoxicology Unit; W. Bourguet, CBS CNRS UMR5048 - INSERM U1054; A. Escande, Université de Montpellier; M. Grimaldi, INSERM / IRCM – U1194; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; P. Balague, INSERM / IRCM – U1194

In the context of contamination of aquatic ecosystems by endocrine disrupting chemicals (EDCs), this work aims to provide new insights on cross-species differences in the modulation of nuclear receptors (NRs) and the aryl hydrocarbon receptor (AhR) by individual chemicals and environmental mixtures, in order to help further cross-species extrapolation in the frame of the environmental risks of EDCs. To this end, a panel of individual ligands and environmental mixtures from an urban wastewater treatment plant (WWTP), were screened on a set of recently developed ligands or mixture (test set) and identified in the primary screen. Cross-species differences occurred (PxR, PpAr, Pr) while for other receptors the differences were lower (ER, AR, GR, MR) or almost absent (AhR, ERR). For instance, promegestone acts as a full agonist of the hPR but as partial agonist of the zfPR whereas the dihydroxy-4-phenogen-3-one reference ligand of the zfPR-antagonizes the hPR. In the same way, none of the reference ligands of the hPRX (T091311) modulates the zfPR whereas the clomiphene mimics a strong agonist of the zfPR-2a- modulates also the hPRX but with lower potency. Then the hAR was more sensitive to the agonist mefiprostone and the antagonist OH-flutamide than the zfAR whereas the dexamethasone was a more potent agonist of the zfGR than the hGR. Also significant differences in selectivity were noted among h and zf ER subtypes. Finally, the in vitro profiling of an urban WWTP confirmed these cross-species differences in terms of level, type (agonist vs antagonist), distribution along the WWTP. For instance, h and zf estrogenic activity was differentially detected in the sludge and the suspended material. In the same way, strong zf anti-androgenic activity was detected in the effluent while no human one can be found. Also, strong zf mineralocorticoid activity was detected in both influent and effluents whereas only h anti-mineralocorticoid activity was detected. Altogether, our results showed that h and zf NRs are, for some of them, differentially modulated by individual chemicals and environmental mixtures. Also, interaction of EDCs towards NRs cannot always be extrapolated between these species highlighting the need to further document NRs modulation between human and fish and associated responses, to improve human health and environmental risk assessment of EDCs.

MO250  
Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
D. E. Damlag, National and Kapodistrian University of Athens / Chemistry; M. Agalou, Biomedical Research Foundation Academy of Athens / Developmental Biology; D. Beis, Biomedical Research Foundation Academy of Athens / Developmental Biology; M. Lamoree, VU University, Department Environment & Health / Department Environment & Health; P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health; N. S. Thaiss, National and Kapodistrian University of Athens / Department of Chemistry

Triclosan (TCS) constitutes a common household product ingredient, given its antimicrobial activity, and has been widely used over the past decades. It enters the sewer system and can be transported to wastewater treatment plants (WWTPs), sewerawers and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgent to evaluate the potentially toxic effects to aquatic organisms. The triclosan has emerged as a powerful model organism to study various aspects of developmental and cell biology, while it provides an alternative model for toxicological studies. The objectives of this study were to assess to what extent TCS induce toxicity in zebrafish embryos. In addition, we evaluated the uptake and biotransformation of TCS by zebrafish and examined whether biotransformation data could be used complementary to the concentration of the parent TCS to induce the induced toxicity. The final goal was to establish a wide-scope targeted metabolomics screening workflow to investigate the induced toxicity in a biochemical perspective and associate the observed toxicity/phenotype with changes in molecular level. Overall, the aim was to highlight a high-throughput testing and incorporating different approaches, for a comprehensive toxicity assessment of environmental stressors in aquatic organisms. The zebrafish embryo toxicity assay was used to calculate the LC50 value of TCS as well as to perform the morphological phenotyping. In addition, a liver specific fluorescent transgenic line (TgLFABP:GFp) was used, to evaluate TCS liver toxicity potential. Concerning the toxicokinetics and the metabolomics experiment, 96 hpf zebrafish embryos were used. Samples were collected at 5 different time intervals, from 30 min to 24 hours post exposure (hpe). Detection and identification of tentative TCS-bio-TPs was performed through in-house developed suspect and non-target screening workflows. Bio-TPs arising from both oxidative and conjugative metabolic reactions were identified. Regarding the metabolomics part of the study, a database of over 600 endogenous metabolites (carboxylic acids, amines, nucleosides…) was established by using a broad range of LC-MS platforms and drug discovery software. To date, Prostaglandin F2-like derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2-isoprostanes (F2-isop). F2-isopTs are the free-radical catalyzed products of non-enzymatic lipid-peroxidation of arachidonic acid, a fatty acid found in brain tissue and cell membranes. Fish mucus has been investigated in several studies as a potential biomarker and a promising tool for fish as a sensitive, species-specific and specific biomarker of oxidative stress. It is composed mainly of glycoproteins, but notably contains immunoglobulins, phospholipids, lysozyme and proteolytic enzymes. Mucus is known to have important biological functions for fish, ranging from communication and reproduction to osmotic regulation. To date, no method for the isolation and quantification of F2-isopTs in fish mucus has been reported. The aims of this study were to develop an efficient method for the extraction of F2-isopTs from fish mucus and to optimize the resolution and quantification of F2-isopTs by high performance liquid chromatography tandem mass spectrometry. The method was based on acidification of mucus with HCl and extracting with ethyl acetate. The
extract was then centrifuged, filtered and reconstituted in methanol. Separations were performed on C18 (2.1 mm x 50 mm, 3.5 µm particle size) using methanol (0.1% formic acid) and water as the mobile phase. Negative ion electrospray ionization and specific multiple reaction monitoring ion transitions were used to detect F2-isoPs in mucus. Mass labelled internal standards were used to monitor recovery of native compounds during sample work-up and also to quantify native F2-isoPs. Native F2-isoPs and F2-Ps from class III and VI F2-isoPs were measurable in Crappie (Pomoxis). This work demonstrates that mucus has the potential to be used as a non-invasive, non-lethal matrix for F2-isoPs analysis in fish.

**MO252** Validation of in ovo embryo microinjections to simulate maternal transfer of selenomethionine in the fathead minnow (Pimephales promelas)∗

T. Lane, University of Saskatchewan; D. Green, K. Raes, University of Saskatchewan - Toxicology Centre / Toxicology; K. Bluhm, University of Saskatchewan / School of Environment and Sustainability; D.M. Janz, K. Liber, L.E. Doug, University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Selenium (Se) is a naturally occurring trace element that is recognized as a contaminant of concern in Canadian aquatic ecosystems because of its high potential to bioaccumulate and persist even after its source has been removed. All animal classes are susceptible to the effects of Se due to the narrow range between dietary essentiality and toxicity; however, oviparous vertebrates, especially fish, are at particular risk to maternal transfer of Se. This study was conducted to develop and validate an embryo injection approach to model maternal transfer of selenomethionine (SeM), the primary form of Se in the diet. This model could then be applied to any egg-laying species of interest and could provide insight regarding differences in species sensitivity to Se toxicity during early life stage development. Initially, the maternal transfer of dietary SeM and its effect on the F1 generation was characterized in a short-term fish study. Freshwater species, the fathead minnow (Pimephales promelas), 20 breeding groups (3 females:2 males) were fed a SeM-spiked diet of either 0, 3, 9, or 27 mg Se/kg bloodworms dry weight (dw) and bred for 28 days. Embryo Se concentrations increased immediately upon onset of exposure and Se concentrations reached approximately a 1:1 ratio in food:embryo after 28 days on the diet. There was a significant difference in mean embryo Se concentrations from the control (1.18 mg/kg embryo dw) in the medium (8.75 mg/kg embryo dw) and high (29.58 mg/kg embryo dw) treatment groups. Embryos collected days 26, 27 and 28 were reared to swim-up and assessed for morphological abnormalities. Preliminary assessment revealed an increasing, although not significant, trend in the frequency of deformed embryos between the control and high treatment groups (p=0.057); however, a more robust analysis is ongoing. Average Se embryo concentrations from this study will serve as the basis for subsequent embryo injection studies in fathead minnow. Developmental endpoints from both studies (e.g. mortality, frequency of deformities, types of deformities, severity of deformities) will be compared to determine if the embryo injection model is an appropriate tool for investigating maternal transfer of Se. This embryo injection model could also support mechanistic and omic-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as walleye, brook trout and northern pike.

**MO253** Preliminary characterization of the rainbow trout intestine using omics based approaches

L.M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences

Intestinal function is central to the physiology, health and disease of numerous organisms. However, little is known about its gene or protein profile in trout, a widely studied and environmentally relevant model laboratory organism (Oncorhynchus mykiss). In this study, two omics based tools focused on characterizing RNA and protein expression were used to establish the ontology of each intestinal region viz. the pyloric, anterior, mid and posterior intestine. RNA Seq was carried out on intestinal regions and mapped back to the rainbow trout genome (84%). Following filtering for transcript abundance using TPM and a p-value cut off, 23,635 – 25,435 contigs were identified over the 4 regions and included enzymes involved in metabolism of chemicals such as the cytochrome P450 family (CYPs). Differential expression of genes between regions did not vary significantly between the pyloric, anterior or mid intestine (~6 genes), however this changed markedly between the pyloric and posterior region (~29) highlighting their differences. Proteomic characterization established over 3,899 proteins present in the intestine with annotated proteins varying from 3,100 to 3,899 dependent on intestinal region. Significant differences in proteins were observed between intestinal regions further confirming trends observed in the parallel transcriptomic study. These data represent the first thorough characterization of the rainbow trout intestine, and will allow the identification of enzymes present in this organ which may be responsible for xenobiotic metabolism.

**MO254** Persistent organic pollutants alter the expression patterns of epigenetic factors in the Zebrafish Liver (ZF-L) Cell line

M. Blanc, Orebro University / MTM Research centre; N. Sherbak, Orebro University / School of Science and Technology, Life Science Centre; S. Keiter, Orebro University / MTM Research centre

Several studies demonstrated that exposure to persistent organic pollutants can induce epigenetic modifications in human and other vertebrate, including fish. It is of particular interest since epigenetic changes were reported in rodents with increasing cancer incidence such as cancer. Besides, epigenetic disruption was suggested to be one mechanism responsible for multigenerational effects of chemical exposure. Epigenetic pathways in zebrafish are similar to mammalians; therefore, it was proposed as an alternative model for epigenetic research. The focus of the present study was set on the investigation of epigenetic effects in the Zebrafish Liver (ZF-L) cell line after 48 h of exposure to 8 selected compounds. The cells were exposed to the LC10 values of pesticides (methoxychlor (MXC), permethrin (PER)), plastic additives (bisphenol A (BPA) and S (BPS)), perfluorinated compounds (perfluorooctane sulfonic acid (PFOS), perfluorobutane sulfonic acid (PFBS)), a whitening agent, 7-dihydrinamine-4-methylcoumarin (DEM); and to the TPA subfamily value cut off, 23,635 isoPs. Native isomers of the Class III and VI Fs were characterized in a short-term fish study. All the compounds studied were characterized in a short-term fish study. The embryo injection model could then be used as the basis for subsequent embryo injection studies in fathead minnow. Developmental endpoints from both studies (e.g. mortality, frequency of deformities, types of deformities, severity of deformities) will be compared to determine if the embryo injection model is an appropriate tool for investigating maternal transfer of Se. This embryo injection model could also support mechanistic and omic-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as walleye, brook trout and northern pike.

**MO255** Cross-species applicability of the adverse outcome pathway “deiodinase inhibition leading to impaired swim bladder inflation in zebrafish” as an environmental monitoring tool

E. Weekers, University of Antwerp / Zebrafishlab Dept Veterinary Sciences SPHERE; H. Witters, VITO / Applied Bio & Molecular Systems; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group); G.T. Ankley, D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; D. Knapen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences

The adverse outcome pathway (AOP) framework can be used to help support the development of alternative testing strategies aimed at predicting adverse outcomes caused by triggering specific toxicity pathways. Previously, we developed an AOP describing how inhibition of deiodinase (DIO) enzyme activity leads to impaired swim bladder inflation in fish. Next we assessed the feasibility of selecting alternative in chemico assays targeting specific key events along the AOP and evaluating the potential of the well-known BPA and PFOS. Overall, the present results showed that ZF-L cells were responsive to epigenetic disruption. They further provided evidence on the potential of chemicals to interfere with both DNA methylation and chromatin accessibility. However, further studies are required to investigate to what extent the observed changes are reflected in DNA methylation and chromatin accessibility themselves, together with their correlation in in vivo models.

**MO256** Adverse outcome pathway (AOP) framework can be used to help support the development of alternative testing strategies aimed at predicting adverse outcomes caused by triggering specific toxicity pathways. Previously, we developed an AOP describing how inhibition of deiodinase (DIO) enzyme activity leads to impaired swim bladder inflation in fish. Next we assessed the feasibility of selecting alternative in chemico assays targeting specific key events along the AOP and evaluating the potential of the well-known BPA and PFOS. Overall, the present results showed that ZF-L cells were responsive to epigenetic disruption. They further provided evidence on the potential of chemicals to interfere with both DNA methylation and chromatin accessibility. However, further studies are required to investigate to what extent the observed changes are reflected in DNA methylation and chromatin accessibility themselves, together with their correlation in in vivo models.
Zebrafish responses to the fourth-generation progestin drospirenone exposures
C. Quintaneto et al.

Department of Biology & CESAM - University of Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; M. Monteiro, Aveiro University / Biology

Synthetic progestins (PGs) represent an important class of active ingredients of hormone-replacement therapies (HRT). The widespread use has led to environmental contamination by these substances. Although the knowledge about their environmental concentrations and effects on fish is still scarce, PGs are rapidly uptaken through fish gills and can cause deleterious effects even at low concentrations, such as the inhibition of fish reproduction. Drospirenone (DRP) arises as one of the most used fourth-generation PGs in hormonal pharmaceuticals. In relation to its endocrine activity, it is known that DRP can interfere with other processes in fish, such on regulation of circadian rhythm. Thus, the present work aims to evaluate Danio rerio early life stages responses to DRP exposures at physiological and biochemical level. Zebrafish embryos were exposed to 0.01 – 100.0 µg/L of DRP during 96h to evaluate lethal and sublethal parameters. Survival, heartbeat, length and impairments on normal development such as malformations and hatching were evaluated in apical and physiological endpoints. Alterations on enzymes related with neurotransmission (acetylcholinesterase, AChE, energy production (lactate dehydrogenase, LDH) and oxidative stress (catalase, CAT and glutathione S-transferase, GST) were assessed. The oxidative damage was also assessed by alterations on lipid peroxidation levels (LPO). Exposure to DRP did not affect hatching rate, growth and development of zebrafish embryos, however, there was a decrease of a number of chemicals were identified as DRPs. Specific biochemical processes were affected by DRP exposure and oxidative damage was observed. Overall, despite not having affected zebrafish early life stages apical endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

MO258
Fish cageing experiment as a tool for detection of in situ effects of untreated wastewaters: General stress and endocrine disruption

Department of Biology and Ecology; B. Millet, Peteca Science Center/Faculty of Sciences, University of Novi Sad / Department of Biology and Ecology; S. Sipos, Faculty of Sciences University of Novi Sad / Biology and Ecology; V. Knezevic, Faculty of Sciences / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX; S. Kašařević, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECO
tOX)

A direct discharge of untreated municipal wastewaters from the city of Novi Sad into the River Danube made a location a focal pollutant hotspot within the framework of FP 7 funded Solutions project. A study conducted previously at this site provided detailed chemical characterization of water samples. Relatively high concentrations of a number of chemicals were identified as DRPs. Specific toxicity was confirmed with a battery of in vitro assays. As a follow-up, a fish caging experiment was conducted with the aim to check if the biological effects observed in vitro can be seen in situ, through a battery of biomarkers in liver and brain of caged fish. Ten specimens of common carp (Cyprinus carpio L., Cyprinidae), both male and female, were exposed for nine days at three sites in the River Danube: untreated sewage (control), discharged sewage without the presence of sewage treatment plant, discharged sewage with the presence of sewage treatment plant. At downstream the major discharge point of the untreated sewage into the River Danube. Certain detected chemicals are recognized causative agents of endocrine disruption and stress in general with a potential to lead to physiological effects. Therefore, stress marker enzyme assays (catalase, carboxylesterase and glutathione s-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytokine and chemokine subunits (i.e. IL-1β, IL-6, TNFα), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor α (era), estrogen receptor β (erβ), androgen receptor (ar), cortisols receptor (cr) and vitellogenin (vtg) as endocrine disruption related genes; interleukin1β (il1β) and tumour necrosis factor (tnfα) as specific immune response related genes, while light chain 3 β (ilc3β) and dynein (dyn) were selected as autophagy related genes. Expression activities were higher in specimens caged at downstream locality, while catalase was lower at sewage discharge point. General stress and endocrine disruption representative genes at downstream site follow the trend of overexpression vs control (reference site), while the vtg was down-regulated at discharge point. Expression of both those two genes was strongly up-regulated at downstream site, while no significant difference was noted among expressions of other immune response and autophagy related genes. The results indicate induction of adaptive stress responses and endurance disruption and are in line with the results observed in vitro.

MO259
Gene transcription ontology of hypothalamic-pituitary-thyroid axis development in early-life stage fathead minnow and zebrafish
L. Vergeen et al.

The hypothalamic-pituitary-thyroid (HPT) axis is known to play a crucial role in the development of teleost fish. However, knowledge of endogenous transcription profiles of thyroid-related genes in developing teleosts remains fragmented. We selected two model teleost species, the fathead minnow (Pimephales promelas) and the zebrafish (Danio rerio) to describe the gene transcription ontology of the HPT-axis. Control embryos were sampled at several time points between fertilization and hatching, and larvae were sampled approximately every other day until 33 days post-fertilization. Total RNA was extracted from pooled, whole fish, and thyroid-related mRNA expression was evaluated using quantitative polymerase chain reaction (qPCR). Gene expression levels are compared in the study species with the results observed in knockdown experiments of PGs in hormonal pharmaceuticals. Furthermore, it can function as a background reference dataset for designing and interpreting targeted transcriptional expression studies both for fundamental research and for applications, such as ecotoxicology.
MO261
Thyroid disruption and its effects on neuronal development of zebrafish
A. Hogan, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); I. Legradì, Vrije Universiteit Amsterdam / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research

The endocrine disrupting effects of estrogenic compounds on humans and different species in the environment are well studied. But despite the growing numbers of patients diagnosed with thyroid disorders, thyroid hormone disrupting effects of compounds are less investigated. Furthermore, it is estimated that many substances found in our environment can influence the thyroid system and act as thyroid hormone disruptors. Thyroid hormones play a critical role in brain development and it has been shown that a lack reduces cognitive development. But the connections between thyroid disruption and developmental neurotoxicity are rarely studied and the basic mechanisms remain unknown. Because the thyroid system is well conserved among vertebrates, effects observed in humans can also be expected in wildlife. Our University of Saskatchewan - Toxicology Centre / Toxicology; T. Lane, University of Saskatchewan; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; J. Taghavimehr, A. Masse, N. Baldwin, University of Saskatchewan / Toxicology Centre; T. Lane, University of Saskatchewan; D. Environment and Climate Change Canada / National Wildlife Research Centre; N. Burgos-Gill, McGill University / Department of Agriculture Sciences; N. Hogan, University of Saskatchewan / Toxicology Centre and Department of Animal and Poultry Science, College of Agriculture and Bioresources; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

MO262
Identification of toxicity pathways predicting adverse outcomes of chlorpyrifos in fathead minnows
K. Bihlm, University of Saskatchewan / School of Environment and Sustainability; A. Sobrino, Universidad Autonoma Metropolitana Iztapalapa / Biologia; J. Salazar Hernandez, Universidad Autonoma Metropolitana Iztapalapa / Biologia

Chlorpyrifos concentrations were selected based on a preliminary bioassay to capture critical toxicity pathways of chlorpyrifos for the prediction of adverse outcomes for the improvement of water quality guidelines. In the evaluation of the AchE activity, significant differences were obtained. In the sublethal bioassays at 72 hours of exposure it was observed that Imiprotrin was more toxic (LC50 = 0.96 ± 0.98 µg L-1) than Dichlorvos (LC50 = 5.3 mg L-1). In the sublethal bioassays it was observed that the toxicity of these xenobiotics increased with the time of exposure. The degree of lipoperoxidation in the imiprotrin tests varied from 64.7 to 147.5 nM Tbars mg-1 protein and was higher than that observed in the bioassays with Dichlorvos (22.6 to 93.8 nM Tbars mg-1 protein). In the fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of the AchE enzyme was observed and from 14% to 64% in the juveniles exposed to imiprotrin. The juveniles of zebrafish that showed a decrease in the activity of the AchE greater than 35% had changes in their swimming behavior and in their feeding. The energy content of the fish exposed to pesticides decreased by 64% in the Imiprotrin tests and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imiprotrin are little persistent in the environment, their half-life is 5 to 8 days, but the results of this study indicate that their effects on organisms are probably irreversible.
Fluoxetine (FLX) is among the top 100 drugs prescribed annually worldwide. This

Chronic exposure to effects of the ayahuasca infusion (FST, suggesting a possible antidepressant effect. These results indicated that the highest

Ayahuasca exposure caused significant developmental anomalies in zebra fish. The aim of this study was to analyze the neurotoxic potential of Vanlifezax in zebra fish 'nlar eventualizing transcriptomic profiles and behavioral alterations. The locomotor activity

Venlafaxine is an antidepressant that acts as a serotonin-norepinephrine reuptake inhibitor, increasing serotonin and norepinephrine neurotransmitter concentrations in brain regions. It was also shown to affect monoamine levels and cause behavioral alterations/inn fish. The aim of this study was to analyze the neurotoxic potential of Vanlifezax in zebra fish 'nlar

demonstrated that chronic exposure of zebrafish to FLX can affect multiple behavioral outcomes such as decreases in glycogen and progressive loss of hepatic architecture. The pattern of swimming behavior of fish changes significantly, fish spend more time at the upper part of the aquarium in concentration above 10 µg/L. Altogether, the present study demonstrated that chronic exposure of zebrafish to FLX can affect multiple endpoint such as growth tissue organization, feeding and swimming behaviour. These results emphasize the relevance of an integrated approach in the ecotoxicological assessment of psychiatric drugs.

MO267
Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
T.S. Andrade, Universidade de Brasilia / Laboratory of Genetics and Toxicology; W. Melo Junior, University of Brasilia; R. Oliveira, State University of Campinas / SCHOOL. OF TECHNOLOGY - UNICAMP; A.D. ANDRADE, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; M.L. da Silva, University of Brasilia / genetic toxicology; J.A. Morais, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Koppe Grisolia, University of Brasilia / Department of Genetics and Morphology; I. Domingues, University of Aveiro / CESAM Department of Biology; E.D. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Pic-Taylor, University of Brasilia / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Spehr, B. Kampa, RWTH Aachen University; H. Holfett, RWTH Aachen University / Institute for Environmental Research

Mitochondrial Disorders of Zebrafish Embryos Exposed to Individual Organochlorine Pesticides and Their Mixtures
H. Lee, Seoul National University of Science and Technology / Environmental toxicology and health; S. Lee, Seoul National University of Science and Technology / Environmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental Engineering

Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure has attracted great attention on pathological and ecological studies. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Chlordane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachlorocyclohexane (beta-HCH)), and their mixtures from 4 to 120 hpf (hours post-fertilization). We measured oxygen consumption rate (OCR) at the embryonic sublethal concentrations of 0.05, 0.1, and 0.5 mg/L by using Seahorse XFe Extracellular Flux Analyzer at 24 hpf. The OCR results are compared with the activity of mitochondrial complex I–IV after isolating mitochondria from embryos at 48 hpf. In addition, we analyzed mRNA expression of transcription factors (i.e., PGC-alpha, Acox1, SDHA, MCAD, and CS), associated with mitochondrial metabolism, at 120 hpf. This comprehensive study could suggest that the embryonic zebrafish model on the methodology and a set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.

MO270
The NeuroBox Project
J. Lee, Vrije Universiteit Amsterdam; A. Haigis, Institute for Environmental Research WURTH Aachen University; M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Spehr, B. Kampa, RWTH Aachen University; H. Holfett, RWTH Aachen University / Institute for Environmental Research

The societal impact of neurological disorders like Alzheimer’s disease or neuromuscular defects like Duchenne muscular dystrophy is immense. In the last two decades, the effects, e.g. severe mental and physical problems, are often devastating. There is mostly no cure available and even treatments to reduce or stop the progression of the diseases are limited. The number of people diagnosed with neurological disorders is increasing. This increase cannot be explained by improved diagnostics and increased age. Exposure to neurotoxic chemicals is suspected to play a role in the development and progression of these diseases. It has been estimated that alone in Europe, exposure to solely endocrine disruptors that lead to neurological disorders, costs society €150 billion per year. This does not include costs due to exposure to known neuroactive substances like pesticides and pharmaceuticals. Currently, testing for neurotoxicity is not required within the EU (REACh) as it is not known how to assess mitochondrial dysfunction. Based on our findings, it is a major challenge to test all substances for their neurotoxic potential, new advanced neurotoxicity assessment strategies need to be developed to fulfill these demands. The bmbf funded project NeuroBox (02WRS1419; coordination UBA, T. Grummitt) aims to develop novel assessment strategies for neurotoxicity assessment of anthropogenic substances in freshwater samples. The work is split over six subprojects. In our sub-project, we use zebrafish embryos to identify neurotoxic mode of actions of commonly found water contaminants. Based on our findings novel screening assays will be developed to easily screen water samples for neurotoxic effects. In combination with mouse models and clinical researchers we will also link our results to mammalian neurological diseases like ADHD and autism and neurodegeneration studies, to identify potential exposure-disease relationships. Furthermore, we will study the link between endocrine disrupting compounds and neurotoxic effects. We could see behavioral as well as metabolomics and transcriptomic changes after exposure to compounds. These

MO268
Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish.
N. de Farias, University of Brasilia / Departamento de Genética e Morfologia; R. Oliveira, State University of Campinas / Department of Genetics and Morphology; T.S. Andrade, Universidade de Brasilia / Laboratory of Genetics and Toxicology; J.M. Pinto, University of Brasilia / Departamento de Genética e Morfologia Instituto de Biologia; C.K. Grisolia, University of Brasilia UnB / Department of Genetics and Morphology

Fluoxetine (FLX) is among the top 100 drugs prescribed annually worldwide. This

selective serotonin reuptake inhibitor is highly detected in aquatic ecosystems and has the potential to modulate levels of serotonin non-target organisms. The present study aims to evaluate the effects of chronic exposure to FLX on fish. Zebrafish juvenile were exposed to FLX during 30 days following the OECD protocol (no. 215). The assays were performed in triplicate with six treatments of FLX, 0; 0.01; 0.1; 1; 10 and 100 µg/L. A total of 60 fish per treatment (20 per replicate) were used. Growth and feeding behaviour were analysed at the end of the test. Histological analyses of liver followed standard H&E routine. Video recordings (10 min) were analysed for swimming behaviour by measuring the time spent by each fish in each of the layers of the aquarium (bottom: 0–5 cm, middle: 6–10 cm and upper: 11–15 cm). Our results showed decrease in growth rate and erratic feeding behaviour at 100 µg/L. Also, in concentrations as low as 0.1 µg/L were observed pathological alterations such as increase in otic vesicles, edema and accumulation of red blood cells. The behavior of fish changes significantly, fish spend more time at the upper part of the aquarium in concentration above 10 µg/L. Altogether, the present study demonstrated that chronic exposure of zebrafish to FLX can affect multiple endpoint such as growth tissue organization, feeding and swimming behaviour. These results emphasize the relevance of an integrated approach in the ecotoxicological assessment of psychiatric drugs.

MO269
Mitochondrial Disorders of Zebrafish Embryos Exposed to Individual Organochlorine Pesticides and Their Mixtures
H. Lee, Seoul National University of Science and Technology / Environmental toxicology and health; S. Lee, Seoul National University of Science and Technology / Environmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental Engineering

Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure has attracted great attention on pathological and ecological studies. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Chlordane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachlorocyclohexane (beta-HCH)), and their mixtures from 4 to 120 hpf (hours post-fertilization). We measured oxygen consumption rate (OCR) at the embryonic sublethal concentrations of 0.05, 0.1, and 0.5 mg/L by using Seahorse XFe Extracellular Flux Analyzer at 24 hpf. The OCR results are compared with the activity of mitochondrial complex I–IV after isolating mitochondria from embryos at 48 hpf. In addition, we analyzed mRNA expression of transcription factors (i.e., PGC-alpha, Acox1, SDHA, MCAD, and CS), associated with mitochondrial metabolism, at 120 hpf. This comprehensive study could suggest that the embryonic zebrafish model on the methodology and a set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (P)

MO272  Effect of iodinated X-ray contrast media in the formation of disinfection byproducts during chlorination and chloramination of water

C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. Armstrong, University of North Carolina at Chapel Hill / Department of Environmental Science and Engineering; S. Caeiro, K. Laman, S. Klimura, A. Cuthbertson, S.D. Richardson, University of South Carolina; T. McDonald, Y.M. Sey, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory; S. Duijker, University of Akron; J. Simmons, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory.

Iodinated X-ray contrast media (ICMs), used in medical imaging, are poorly metabolized by humans and enter wastewater. As they are incompletely removed during wastewater treatment, ICMs are released to the aquatic environment and have been detected in drinking water sources. ICMs have been identified as iodine sources that may enhance the formation of iodine-containing disinfection byproducts (IBPs) during disinfection processes. The presence of ICMs in drinking water may increase the production of IBPs, including dibromochloromethane, bromodichloromethane, chloroform, and bromoform.


MO274 Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers

V. P. Jimeno Melia, Catalan Institute for Water Research (ICPAS); J. SEVERYS, AQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICARAs; V. P. ROMERO, H. K. Libartore, K. Laman, S. Klimura, A. Cuthbertson, S.D. Richardson, University of South Carolina; T. McDonald, Y.M. Sey, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory.

Microcontaminants, such as pharmaceuticals and personal care products, are ubiquitous in surface waters. The presence of these contaminants in water sources can pose risks to human and ecological health. It is crucial to understand the sources, occurrence, and health effects of these contaminants to develop effective strategies for their mitigation.

Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers involves a complex decision-making process. This presentation will discuss the methodologies and strategies used to balance these competing priorities, highlighting the importance of interdisciplinary approaches in water resource management.

hydrological conditions in the Llobregat). Finally, we demonstrated that the reduction of uncertainty in the modelling process (through R&D activities) provides transparency in the decision-making process.

**MO275**

**Calibration of passive samplers for the monitoring of drugs in French Caribbean**

N. Tapie, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; D. Devault, Univ. Paris Sud / ESE UMR 8079; S. Karolak, Univ. Paris Sud, CNRS, AgroParisTech / ESE UMR 8079; Y. Levi, Univ. Paris Sud / ESE UMR 8079; H. Budzinski, University of Bordeaux

Drugs are more and more consumed worldwide (ONUDC, 2017). The French Caribbean is a hub of world cocaine trafficking and an important place of consumption of cocaine in the form of crack. The local population is particularly affected by this scourge. The consumption of illicit drugs induces the excretion of parent compounds or metabolites (markers of drugs uses) in wastewater, and in the end their release into the aquatic environment. So, one of the ways to evaluate the local use of illicit drugs is to track drug residues in wastewater treatment plants (WWTP). The present study that takes place in the SENEUR Project and explores the use of passive sampling techniques to monitor illicit drugs in WWTP. Polar Organic Chemical Integrative Samplers (POCIS) were exposed in situ in a Waste Water Treatment Plant in Martinique (French Caribbean) during ten days. First an analytical development by ESI-LC/MS/MS was done in order to be able to analyze 17 compound as markers of drug uses (cocaïne, heroin, amphetamine, cannabis, their main metabolites and some substitute products such as methadone) and to set a correlation between the measurement point and the PE of discharging treatment plants within the catchment. According to the local sanitary pressures in Luxembourg, we define sanitary pressure as the substances in the whole hydrological network. Here we used passive samplers to address the difficult analytical challenges for a complex class of emerging compounds that can range a lot in terms of polarity. Reverse Phase Liquid Chromatography (HILIC) is needed. HILIC has been established since years as an alternative approach to the use of classical class of emerging compounds. These compounds can range a lot in terms of polarity. Reverse Phase Liquid Chromatography (HILIC) are needed. 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RPLC-HILIC-ToF/MS system. The analysis data were then processed following a non-target screening workflow for very polar compounds. After importing the data in STOFF-IDENT database, a proposed list of possible compounds in the samples was created. Using reference standards of the proposed compounds and MS/MS fragmentation data, it was possible to positively identify nine very polar compounds, of which six have not been reported previously in water surface samples.

MO281 Analysis of Per/Polyfluoralkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements

T. Anamal, T. Toolevezi, T. Sosienki, Agilent Perfluorinated substances (PFASs) are perfluorocarboxylic molecules that have a C-F bond in the alkyl chain and have a range of industrial uses and can be found in various household items and consumer goods. PFASs however can have adverse health effects while longer (C-chain >7) PFASs are bioaccumulative. PFASs are extremely persistent and have been detected in numerous environmental matrices. Consequently, the USEPA has public health guidelines in drinking water for two PFASs, namely perfluoroheptane sulfonate (PFHxS) and perfluorononanoic acid (PFNA) at 70 ng/L. However, several other PFASs are also used in manufacturing and need to be monitored. To respond to this, a method was developed for the detection of PFASs in drinking water using a newly developed triple-quadrupole mass spectrometer and a modified high-performance liquid chromatography system. The USEPA has developed a method for analysis in drinking water for 14 PFAS and this method expands on that method with lower detection limits, and more QAV/QC data. The water samples were extracted with solid phase extraction using a novel weak anion exchange cartridge which was optimized to achieve good recoveries for all compounds and will be presented. Several different classes of PFASs including perfluorocarboxylic acids (PFCAs), perfluorosulfonic acids (PFASs), sulfonamides (FOSA), sulfonamide acetic acids (FOSAAs) and others were separated on a liquid chromatography (LC) using a reversed-phase C-18 column. Since fluoropolymers are used in all LC systems, special precautions including replacing solvent lines and addition of a delay column were employed to avoid PFAS background contamination. The compounds were analyzed in negative electrospray ionization using a tandem quadrupole mass spectrometer in dynamic multiple reaction monitoring (DMMRM) mode. Water samples were extracted using both an offline and automated online solid phase extraction techniques and the data was compared. All PFASs were analyzed and method performance parameters such as method detection limits, inter- and intra-day repeatability, matrix spike recoveries and other QA/QC criteria were evaluated. All recoveries were with 70-125% with %RSDs well below 15% that are needed to meet USEPA 537 requirements. The method was validated on environmental samples from different rivers and streams and validated using values greater than 0.996. The MCs eluted between 2.2 – 5.2 minutes allowing for the analyses to be 3) MC-RR, [Asp]-MC-1R, MC-Hil and MC-WR at concentrations above the low health reference level of 21 ng/L. Our data suggests that 1) by not including 12 MCs in Method 544, the true risk potential of exposure to MCs in drinking and recreational waters will be underestimated greatly, and 2) an umbrella method does not need to be modified. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO284 Development of a LC-MS/MS-based method for screening of non-targeted chemicals of potential concern in northern pike.

L. Tian, McGill University; J. Reining, Université du Québec à Montréal / Department des sciences biologiques; J. Verreault, Université du Québec à Montréal / Department of Biological Sciences; M. Houde, Environment and Climate Change Canada / Aquatic Contaminants Research Division; S. Bayen, McGill University / Singapore-Delft Water Alliance

Fish and seafood contaminant monitoring traditionally relies on the surveillance of known chemicals, an approach referred to as targeted analysis. However, very few tools are available to monitor “unexpected” or "unknown" compounds. Non-targeted approaches are particularly useful to detect emerging contaminants in items related to the human diet such as fish and seafood. The non-targeted approach is however quite challenging for trace contaminant analysis as it involves isolating relatively small signals from complex matrices, and this, in absence of a good knowledge about the analyte identity. In the past decade, the coupling of liquid chromatography, high-resolution tandem mass spectrometry (HRMS/MS) and advanced data processing algorithms has proved to be a robust approach for the analysis of unknown molecules in biological samples. In this study, a non-targeted workflow was developed with the objective to detect/identify unexpected organic contaminants in a predator fish from the St. Lawrence River (QC, Canada), the northern pike (Esox lucius), with a focus on chemicals originating from plastic materials. An optimized method was applied to pike tissue sampled upstream and downstream of the Montreal’s wastewater treatment plant. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software for the presence of other unexpected contaminants. The final confirmation of various substances of interest (e.g. PFOS) was investigated through the comparison with analytical standards. Results indicated that the non-targeted workflow optimized in this study can successfully identify unexpected chemical residues in fish matrices.

MO285 Prioritising site-specific emerging contaminants in surface water based on LC-HRMS nontarget screening data

M. Krauss, C. Hug, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; R. Bloch, Helmholtz Centre for Environmental Research GmbH / UFZ; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / UFZ / Effect-Directed Analysis

HRMS allows for the non-targeted detection of chemicals in water samples. However, the majority of the several thousand compounds detected in a typical surface water sample remains unknown. Despite we can expect further progress in HRMS-based screening approaches and compound identification, it seems unlikely that monitoring efforts will ever exceed several hundreds of compounds due to financial and time restrictions. Thus, a prioritisation is necessary, guiding decisions on the selection of compounds to monitor and to study at specific sites. Here, we propose an approach to prioritize site-specific compounds solely from LC-HRMS data based on automatically retrieved information and a rarity score derived from signal intensity and frequency of occurrence. The approach was applied to a set of 31 sites using data from different rivers and streams and validated using data from the Saale and Mulde catchments in Germany. They were solid-phase extracted and analysed using LC-HRMS using an LTQ Orbitrap in ESI+ and ESI- mode. After peak picking using the MZmine 2 software, blank peaks were removed and isotopologue peaks, adduct peaks, and homologue series were detected using the R package “nontarget”. Rarity scores were calculated for all detected compounds as ratio of maximum and median peak intensity across all samples divided by the ratio of the number of positive detections and the total number of samples. The distribution of rarity scores was similar for ESI+ and ESI- mode, with about 80% of the detected peaks (about 31,000 in ESI+ and 15,000 in ESI- mode) showing values between 10 and 100, while roughly about 1% of peaks had values above 1000 which might be considered as a threshold level for “rare”, site-specific compounds in our dataset. The occurrence of these rare peaks at the individual sites differed considerably from 0 to 91 in ESI+ and 0 and 48 in ESI- mode. At two sites, the presence of a high number of rare peaks (48 in ESI- mode) coincided with the largest number of sulfur-containing compounds as indicated by isotopologue
annotation. These sulfur-containing compounds could be identified as various derivatives of naphthalene sulfonic acids and have to be considered as a site-specific contaminants, as they were not present at any other sampling site. Thus, the proposed approach is suitable to rapidly characterize surface water samples and allows for a prioritization of sites or compound groups for further in-depth studies.

**MO286**

Analysis of Phenanthrene Transformation Products Using High-Resolution Mass Spectrometry Coupled to High-Performance Liquid Chromatography

M. Leonard, Oregon State University / Environmental & Molecular Toxicology; J. Schlaf, Oregon State University / Environmental and Molecular Toxicology; S.L. Michael Simonet, Oregon State University / Department of Environmental and Molecular Toxicology

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants generated by the incomplete combustion of organic compounds. Several PAHs have been identified as toxic, mutagenic and/or carcinogenic, which has led the United States Environmental Protection Agency (US EPA) to list 16 PAHs as priority pollutants. PAHs can be metabolized by mammals and some microbes to form hydroxylated PAHs (OH-PAHs) and a variety of other transformation products (TPs). These TPs have the potential to be more toxic than their parent PAHs, but they are not included on the EPA priority pollutant list. Hence, they are often not screened for in environmental samples. Non-targeted screening based on high-resolution mass spectrometry (HRMS) coupled to high-performance liquid chromatography (HPLC) has become a popular tool to identify TPs in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. C₁₈, phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxyphenanthrene (OH-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C₁₈ and phenyl-hexyl columns using a gradient of water/acetonitrile (mobile phase A) and a mixture of acetonitrile and methanol (mobile phase B). Gradient elution beginning with a relatively high percentage of organic solvent (≥ 70%) yielded satisfactory separation and peak shape without the use of an additive or buffer. Detection was carried out with a high-resolution time-of-flight (TOF) MS employing electrospray ionization (ESI) in negative ion mode. The high organic solvent composition of the eluent enabled optimal ESI performance. Consequently, spectrometric sensitivity was preserved throughout each analysis. Further investigation will determine whether the fluoro-phenyl column is suitable for separation of OH-Phe isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

**MO287**

Strategies to monitor transformation products in the water cycle


Transformation products (TPs) are formed in the water cycle through both biological and chemical processes. Data have shown that TPs can be present in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. C₁₈, phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxyphenanthrene (OH-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C₁₈ and phenyl-hexyl columns using a gradient of water/acetonitrile (mobile phase A) and a mixture of acetonitrile and methanol (mobile phase B). Gradient elution beginning with a relatively high percentage of organic solvent (≥ 70%) yielded satisfactory separation and peak shape without the use of an additive or buffer. Detection was carried out with a high-resolution time-of-flight (TOF) MS employing electrospray ionization (ESI) in negative ion mode. The high organic solvent composition of the eluent enabled optimal ESI performance. Consequently, spectrometric sensitivity was preserved throughout each analysis. Further investigation will determine whether the fluoro-phenyl column is suitable for separation of OH-Phe isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

**MO288**

Application of high-resolution mass spectrometry to identifying chlorinated transformation products of aromatic emerging contaminants in wastewater

X. Lin, TUNGHAI University; W. Chen, J. Cheng, TUNGHAI University / Department of Environmental Science and Engineering

Chlorination could remove some aromatic emerging contaminants (ECs) in wastewater, but may also convert the ECs into unknown transformation products (TPs). This study developed a method to systematically identify the TPs of multiple aromatic ECs using high-resolution mass spectrometry (HR-MS) and traced the parent aromatic ECs of the TPs. We spiked ten aromatic ECs (5000 ng/L) into 100-mL Milli-Q water. The water was chlorinated at an initial chlorine of 0.7 mg/L for ten minutes. The full-scan mass chromatograms of both the chlorinated (n = 6) and the untreated (n = 6) water samples were acquired using ultra-performance liquid chromatography-quadrupole-time-of-flight mass spectrometry. By comparing the compound profiles, we evaluated the removals of aromatic ECs and discovered novel signals of some TPs. We also characterized the formation of the TPs using database searching and isotopic-pattern comparison. The parent aromatic ECs of the TPs were then traced back by spiking each aromatic EC to one 100-mL Milli-Q water. Eight of the aromatic ECs were partly removed by chlorination, where triclosan showed the highest removal (99.4%), followed by bisphenol A (72.5%). Nine of the features that were present in the chlorinated and absent in the untreated water samples were indicated as TPs. The results of database searching and isotopogram comparison showed that the molecular formulae of all of the nine TPs contain at least one chlorine. Each chlorinated TP was then successfully traced to one aromatic EC. The nine TPs were transformed from five aromatic ECs, including all of the four parabens and triclosan, by replacing one or two hydrogens with chlorine atoms. The HR-MS method successfully identified nine chlorinated TPs. The results of this study demonstrated that parabens and triclosan could be transformed into more persistent, bioaccumulative, and toxic chlorinated compounds. The proposed method will be applied to the systematic identification of TPs in real water samples containing multiple ECs.

**MO289**

Unravelling the potential of a partial nitritation/anammox biomass towards micropolllutants biodegradation


In the past few years, anammox-based processes have attracted a lot of attention for their implementation at the mainstream line of wastewater treatment plants, due to the possibility of leading to energy autarky if combined with anaerobic digestion. However, little is known about the potential degradation of micropolllutants by the microbial groups responsible of these processes and the few results available are inconclusive. This study aims to assess the degradation capability of biomass withdrawn from a partial nitritation/anammox ammonium oxidation (PN/A) pilot plant towards five pharmaceutically active compounds (ibuprofen, sulfamethoxazole, metropol, venlafaxine and carbazamazine). Batch experiments were performed under different conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitrifying bacteria), iii) aerobic conditions with allylthiourea (an inhibitor of ammonia oxidizing bacteria), iv) anoxic (optimal for anammox bacteria), v) aerobic with acetate (optimal for heterotrophic bacteria) and vi) anoxic with acetate (optimal for heterotrophic denitrifying bacteria). Ibuprofen was the most biodegradable compound, being significantly degraded under all conditions tested except heterotrophic denitrification. Sulfamethoxazole and metropol showed good percentages of removal under certain conditions (up to 70% and 62%, respectively), suggesting the specificity of different microbial groups towards the degradation of these compounds. Finally, carbazamazine and venlafaxine were hardly removed (≤ 10% in the majority of cases). Results demonstrate that the activation of different microbial groups in combination with altering operational parameters can actually enhance the removal of some of the studied micropolllutants.
operated for 1.5 HRTs, after which four samples were taken over 6 hours. The results showed that with the different acetate additions, the effluent oxygen concentration decreased, reaching the lowest value of 0.98 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the effluent increased always to initial conditions (4.7 mg/L) in each starving phase between the feeding phases with acetate. The acetate addition resulted in three different compound dependent removal patterns for the pharmaceuticals. Briefly, untreated and inohexyl removal was attributed to co-metabolism (enhanced with acetate). Metoprolol, iomeprol, diclofenac, propranolol and sulfamethizole removal were removed 1) at lower acetate concentrations by co-metabolic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, sulfadiazine, sulfamethoxazole and trimethoprim were removed independently of acetate concentration, which could be termed as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the biofilm’s performance.


The consumption of pharmaceuticals increases annually due to a variety of reasons involving affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropollutants regularly, focusing on priority micropollutants of clinical importance involved in biological processes has been recommended. Therefore, there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale fill&draw 10L aerobic reactor (sludge age of 5 days; @22°C) was initiated with sludge sample taken from a municipal wastewater treatment plant located in İstanbul. The culture was fed daily with a synthetic wastewater (ISO 8129) (600 mg COD/L) and 50 mg/L acetate. To assess the acute inhibition of these pharmaceuticals, micropollutants respirometric assays were conducted with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75g/L of each; Naproxen, Dichlofenac, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and Aquasim2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10g/L PMx did not result in considerable change compared to control culture, but upon addition of a higher concentration (i.e., 75g/L) there was an increase in the initial substrate consumption rate and decrease in the OUR curve. A removal efficiency in the range of 33-55% was observed for tested pharmaceuticals at the end of the respirometric assays. Measurements showed that pharmaceuticals were not accumulated in sludge phase (≤ +0.2%). Modelling studies reflected that maximum hydrolysis rate of slowly hydrolysable COD ($k_1$) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50g/L. When the concentration of PMx increased from 10 to 50g/L, an increase in the initial COD value of slowly hydrolysable COD was noticed. Furthermore, 75g/L PMx resulted in differentiation in organic matter structure which caused a change in the maximum hydrolysis rate ($k_1$) and hydrolysis rate constant ($k_2$) for readily hydrolysable COD ($S_h$). The results of this study will help to clarify toxic effects of micropollutants on microbial systems as well as will provide valuable data for the discharge of these chemicals into the environment. This work is partially supported by TUBA-GEIPB Award of Turkish Academy of Sciences and BAGEP Award of Science Academy Society of Turkey.

MO292 Elimination of tramadol and methadone in model ozonation experiments: removal kinetics and identification of transformation products P. Kosanjevecki, Rudjer Boskovic Institute; J. Curko, Faculty of Food Technology and Biotechnology; M. Matosic, Faculty for Food Technology and Biotechnology; M. Makombe, Cape Peninsula University of Technology / Chemistry; B. Silwana, Durham university; M. Makombe, Cape Peninsula University of Technology / Chemistry; E. Iwohua, University of The Western Cape / SensorLab Department of Chemistry; V. S. Somerset, CPUT / Chemistry

The determination of the remaining concentration of selected compounds as well as identification of transformation products performed during the experiment were performed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. The experiment showed that ozonation at an ozone dosage of 0.05 - 0.5 mg/L completely removed both opioid compounds in less than 5 min in pure water and phosphate buffer solution, providing that pH of the ozonation medium was higher than 7. The elimination of opioids was significantly slowed down at acidic conditions, which indicated the importance of the amino group deprotonation for an efficient reaction with ozone. Elimination of selected compounds in secondary effluent was much slower than in organic-free water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two major transformation products characteristic by m/z 250 and 280 for tramadol and 278 and 294 for methadone. The most abundant transformation products of tramadol and methadone were tentatively identified as tramadol N-oxide and EDDP, respectively.

MO293 Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water C. Raimundo, UNICAMP / Institute of Chemistry; K. H. Cochran, B. Fryer, University of South Carolina; S. Kimura-Hara, University of Calgary; W. Abdelraheem, Y. Huang, University of Cincinnati; S.L. Coffin, University of California, Riverside / Environmental Toxicology; D. Schlenk, University of California, Riverside / Environmental Toxicology; C. Raimundo, UNICAMP / Department of Environmental Sciences; D. Dionysiou, University of Cincinnati / Department of Biomedical, Chemical and Environmental Engineering (DBCEE); S.D. Richardson, University of South Carolina

Furthermore, removal rates in the range of 60-75% were observed during ozonation at ozone dosages of 6 mg/L. Therefore, the aim of this work was to examine the removal of two opioid analgesics, tramadol and methadone, using ozonation. The experiments were performed in three different matrices: synthetic wastewater prepared with the AOC leachate as a carbon source and treated wastewater from the full-scale advanced wastewater treatment plant at Fullerton, California, Riverside / Environmental Toxicology; M. Green, E. Topuz, G. Yuksek, E. Ubay Gokgor, D. Okutan-Tas, Istanbul Technical University / Environmental Engineering

The consumption of pharmaceuticals increases annually due to a variety of reasons involving affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropollutants regularly, focusing on priority micropollutants of clinical importance involved in biological processes has been recommended. Therefore, there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale fill&draw 10L aerobic reactor (sludge age of 5 days; @22°C) was initiated with sludge sample taken from a municipal wastewater treatment plant located in Istanbul. The culture was fed daily with a synthetic wastewater (ISO 8129) (600 mg COD/L) and 50 mg/L acetate. To assess the acute inhibition of these pharmaceuticals, micropollutants respirometric assays were conducted with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75g/L of each; Naproxen, Dichlofenac, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and Aquasim2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10g/L PMx did not result in considerable change compared to control culture, but upon addition of a higher concentration (i.e., 75g/L) there was an increase in the initial substrate consumption rate and decrease in the OUR curve. A removal efficiency in the range of 33-55% was observed for tested pharmaceuticals at the end of the respirometric assays. Measurements showed that pharmaceuticals were not accumulated in sludge phase (≤ +0.2%). Modelling studies reflected that maximum hydrolysis rate of slowly hydrolysable COD ($k_1$) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50g/L. When the concentration of PMx increased from 10 to 50g/L, an increase in the initial COD value of slowly hydrolysable COD was noticed. Furthermore, 75g/L PMx resulted in differentiation in organic matter structure which caused a change in the maximum hydrolysis rate ($k_1$) and hydrolysis rate constant ($k_2$) for readily hydrolysable COD ($S_h$). The results of this study will help to clarify toxic effects of micropollutants on microbial systems as well as will provide valuable data for the discharge of these chemicals into the environment. This work is partially supported by TUBA-GEIPB Award of Turkish Academy of Sciences and BAGEP Award of Science Academy Society of Turkey.
rate of total Cd(II) from actual wastewater was 89.25%. Furthermore, the monolayer adsorption capacity of Cd(II) based on the Langmuir model was measured to be 90 mg/g. Results were satisfactory when employing the adsorbent for removal of Cd(II) from wastewater samples. Keywords: Adsorption, Bioavailability, Monitoring, Wastewater.

MO296 WATER JPI Project FRAME: A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse

Indirect Potable Reuse (IPR) provides options to maintain sufficient water quantities for reuse. Efficient and affordable strategies for IPR are needed to minimize impacts from a broad range of contaminants of environmental concern (CECs) and to preserve ecosystem services and human health. The project FRAME (A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse) is funded by the European research initiative “Water JPI (Joint Programming Initiative, Water Challenges for a Sustainable Europe)”. Principal treatment design and performance: (i) to evaluate treatment processes with combined analytical, toxicological and microbiological approaches; (ii) to evaluate advanced treatment options in a multiple barrier approach to improvement of CECS and inactivation of pathogens; (iii) to integrate the experimental results in treatment process models and groundwater models to describe the fate of CECS; (iv) to provide a decision support tool for stakeholders, considering process performance and feasibility assessment for treatment scenarios. Advanced treatment options are applied in a multiple-barrier treatment approach at laboratory and full-scale, specifically to improve the removal of CECS, inactivation of pathogens and improvement of other health-related parameters. Detailed fate studies are included to elucidate transformation pathways of CECS and to identify transformation products (TPs) formed in biological processes. Multi-residue analysis methods were developed for sensitive analysis of 176 CECS, including 12 PFAS. The majority of quantitation limits are in the range of 0.5 ng/L to 50 ng/L. Sorption of charged CECS onto Fe-oxides and other minerals was simulated with the goal to create a sorption model for complex soil compositions. Treatment process models using kinetic modelling of CEC and pathogen removal were implemented—designed for integration into a decision support system for stakeholders. Results at laboratory and full-scale showed that a sequential biofilter approach at pilot scale shows higher efficiency than conventional single-stage biofilters; the monitoring of full-scale secondary effluent infiltration sites reveals attenuation of certain CECs, while others require further treatment, highlighting the need for a multi-barrier approach to IPR.

MO297 Evaluation of Rainwater collected from Concrete underground tank and other storage tanks in Owerri Imo State, Nigeria
A. Okeke, University / Chemistry
ABSTRACT Due to the lack of public pipe borne water supply in Owerri municipality and its Environs in Imo State, South-Eastern Nigeria, many individuals have developed different techniques for rainwater storage harvesting for drinking and water use. Consequently, it is very important to evaluate the quality of rainwater harvested and stored in these different storage tanks so as to ascertain their impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage facilities commonly used by general populace in Owerri (Metal drum tank, concrete underground tank, PVC coated basin for rainwater). The physiochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with the health risk of about 106. An study on metal drum tank based on the heavy metal content. For bacteriological analysis, the concrete underground tank recorded the presence of pseudomonas which exceeds the WHO standard stipulated for portable water. The results further explained that concrete underground tank and metal drum tank were more contaminated in terms of physiochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes. Keywords: Harvested Rainwater, microbiological analysis, physiochemical analysis, storage facilities, trace metals

MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health
C. Allen, L. Jones, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; R.U. Halden, Arizona State University / Biodesign Center for Environmental Security; A. Staines, Dublin City University / School of Nursing and Human Sciences and DCU Water Institute; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinylchloride and as additives in personal care products. Over 2135 kg of phthalates are produced globally each year with end use products including food packaging, paints, tubing and medical devices. Due to their high production volume and continuous release, phthalates are emerging contaminants ubiquitous in the environment. Research has shown that the widespread exposure to these chemicals has been associated with numerous adverse health effects including impaired reproductive health in males, decreased neurological development in children, cancer and obesity. As a result, some phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys). As new research emerges indicating that substitute plasticizers also contribute to adverse health effects, these restrictions are likely to increase. The present project constitutes the first application of sewage epidemiology to determine phthalate exposure in an Irish population. Phthalate levels in influent, effluent and sewage sludge (biosolids) are being monitored by GC-MS and LC/MS analysis; tracking the cycle of phthalates throughout the wastewater system. Phthalate biomarkers are being analysed in influent to assess phthalate exposure. A meta-analysis on health risk data serves to relate the level of exposure to an associated risk, providing the first step in phthalate risk assessment within the Irish environment. Results will inform on the feasibility of using sewage biomarkers for future compliance monitoring. Metabolites from the following phthalates are considered for inclusion: benzylbutylphthalate (BBP), dibutylphthalate (DBP), di(2-ethylhexyl)phthalate (DEHP), diisobutylphthalate (DIBP), di-n-octylphthalate (DONP), diisononylphthalate (DINP), and diisodecylphthalate (DIDP). This study is part of a large-scale project representing an international collaboration between three research centres Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assessing the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

MO299 Phthalates and their metabolites in the environment
L. Jones, Dublin City University / Biotechnology and Chemical Sciences; C. Allen, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; A. Staines, Dublin City University / School of Biotechnology and DCU Water Institute; R.U. Halden, Arizona State University / Center for Environmental Health Engineering; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates or phthalate esters are a group of synthetic organic chemicals that are used as plasticisers in a wide range of consumer products. They are most commonly used as plasticisers in polyvinyl chloride (PVC) and phthalates have been used in the plastics industry for more than 80 years. As phthalates are so commonly used, their impact on the environment and human health has been extensively studied. Phthalates have been found to be recalcitrant, ubiquitous within the environment, and in many cases, detrimental to human and animal health. This project represents an important collaboration between three research centres (DCU, ASU, & NIVA) with support from Irish Water, Panda and Field Chemicals Co. Ltd, to assess the potential sources and environmental fates of priority phthalates in Ireland. This project is supported by several by studies carried out in Ireland already (DCU) and a vast array of literature in the area of priority pollutant monitoring. The impact of such study would be the analysis of these eleven phthalates from source to fate, in order to inform environmental policy on the risks posed by phthalate usage. The phthalates included in this study are: Benzylbutylphthalate (BBP), Butylbenzylphthalate (BBP), Dimethylphthalate (DMP), Diethylphthalate (DPP), Diisobutylphthalate (DIBP), Di-n-octylphthalate (DONP), Diisononylphthalate (DINP), and Didecylphthalate (DDP). A selection of phthalate monoaesters have also been included in this study to evaluate human exposure to phthalates. Research into the human health effects of phthalates is far from complete, and while phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys), new research is emerging which indicates that substitute plasticizers have similar deleterious health effects. This research is timely as the
extent of phthalate contamination within Ireland, and the impacts on human health, are unknown.

MO300
Poly- and perfluoroalkyl substances (PFASs) in the sewage system of the Bordeaux city: high contribution of unidentified precursors of perfluoroalkyl acids.
C. Simonnet-Laprade, University of Bordeaux UMR EPEQ; P. Labadie, UMR CNRS EPEQ Univesite Bordeaux / UMR 5805 EPEQ; M. Capdeville, L'HyRE Centre de Recherche et Développement SUEZ; P. Pardon, UMR CNRS EPEQ Universite Bordeaux / UMR EPEQ 5805; H. Budzinski, University of Bordeaux

This study proposes to identify the origin of 30 poly- and perfluoroalkyl substances (PFAS) identified in a French city (Bordeaux, Metropolis). For this purpose, 16 samples of domestic wastewaters, 10 samples of wastewaters impacted both by industrial and commercial activities were collected within the sewage network upstream typical and representative treatment plants; in addition 4 samples of runoff waters were also targeted in order to explore the input of this type of potential source. PFASs were also analyzed in the influents, the effluents, and the sludges of the 4 main wastewater treatment plants (WWTP) of Bordeaux Metropolis to quantify global inputs to the natural aquatic environment. The results highlight distinct patterns and levels of contamination between different types of samples and potential sources. Overall, wastewaters impacted by industrial inputs have the highest levels ($\Sigma$PFAS = 4.6-501.7 ng.L$^{-1}$) with the predominance of PFOS, PFHxS, C$_8$-C$_{12}$ PFCA and 6:2 FTSA. High levels of 6:2 and 10:2 FTSA (> 10 ng.L$^{-1}$) were found in wastewaters from the harbor area and a major industrial area. Domestic wastewaters have the highest levels of 6:2 diPAP (median concentration of 4.5 ng.L$^{-1}$), probably related to its use in food packaging. Concerning runoff waters, the highest levels are found in the airport area with $\Sigma$PFAS of 227 ng.L$^{-1}$. The comparison of the profiles with those found for WWTP influents using a principal component analysis made it possible to highlight the importance of the industrial and commercial discharges on the global contribution to WWTPs. It has been possible to quantify global fluxes of PFASs to the four WWTPs and they were estimated at about 14 g.d$^{-1}$ for the sum of targeted PFASs; concerning removal in WWTPs, only the C$_{10}$-C$_{12}$ PFCAx, the PFOS and their precursors with more than 8 perfluorinated carbons were shown to be partially or totally removed by the treatment processes. In addition to the targeted analysis and in order to estimate the proportion of unidentified perfluoroalkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Sedlack (2012) was applied to each of the matrices. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C$_{10}$-C$_{12}$ PFCAx in all the matrices representing 32% (in runoff water) to more than 90% (in domestic wastewaters) of the total PFAS molar concentrations.

MO301
Antibiotics and endocrine disrupting compounds in wastewater treatment plants and in receiving water bodies around the city of Rome (Italy)

Several studies highlighted the occurrence of organic micropolutants such as pharmaceuticals residuals, ingredients of personal care products and endocrine disrupting compounds (EDCs) in wastewaters and surface waters with the aim to quantify and understand the fate of these compounds within the sewage treatment plants to be able to design and construct more efficient future plants, as well as an aid in risk assessment of these chemicals. The aim of this study was therefore to determine detailed mass flows of eleven antimicrobial compounds within three Swedish sewage treatment plants. In total, the three plants were sampled for nine days for samples representing the major flows in respective plant i.e., incoming wastewater, treated effluent, wastewater after the primary clarifier, primary sludge, surplus sludge, digested sludge. All samples were analysed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The compounds included different quaternary ammonium compounds (QACs), such as 12-BAC, 14-BAC, DDMAC, CPC and CTAB as well as other compounds such as chlorhexidine, benzenzotriazole, ciprofloxacin and fluconazole. QACs and chlorhexidine were efficiently removed from the water phase (~99% reduction) but the majority remained in the digested sludge. The total yearly loads in the treated effluent in three studied plants was 29.4 kg and 2900 kg in the digested sludge. For more polar compounds such as trimethoprim and fluconazole, about half of the amount found in the incoming sewage water was found in the treated effluent. To our knowledge this is the first detailed mass balance study for QACs and chlorhexidine reported. The study provides not only new scientific understanding but also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO302
Mass flows of antimicrobial compounds in Swedish sewage treatment plants
M. Östman, J. Fick, M. Tysklind, Umea University / Department of Chemistry

Antimicrobial biocides are used as disinfectants, antiseptics and preservatives to prevent unwanted microorganisms. In the same manner as antibiotics, they are entering our sewage system and passing on to the sewage treatment plants. Sewage treatment plants has been suggested as a possible high-risk environment when it comes to development of antibiotic resistant bacteria. Concerns has been raised that biocides might promote antibiotic resistance via cross- and co-resistance mechanisms. It is therefore important to quantify and understand the fate of these compounds within the sewage treatment plants to be able to design and construct more efficient future plants, as well as an aid in risk assessment of these chemicals. The aim of this study was therefore to determine detailed mass flows of eleven antimicrobial compounds within three Swedish sewage treatment plants. In total, the three plants were sampled for nine days for samples representing the major flows in respective plant i.e., incoming wastewater, treated effluent, wastewater after the primary clarifier, primary sludge, surplus sludge, digested sludge. All samples were analysed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The compounds included different quaternary ammonium compounds (QACs), such as 12-BAC, 14-BAC, DDMAC, CPC and CTAB as well as other compounds such as chlorhexidine, benzenzotriazole, ciprofloxacin and fluconazole. QACs and chlorhexidine were efficiently removed from the water phase (~99% reduction) but the majority remained in the digested sludge. The total yearly loads in the treated effluent in three studied plants was 29.4 kg and 2900 kg in the digested sludge. For more polar compounds such as trimethoprim and fluconazole, about half of the amount found in the incoming sewage water was found in the treated effluent. To our knowledge this is the first detailed mass balance study for QACs and chlorhexidine reported. The study provides not only new scientific understanding but also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO303
Herbicides and fungicides in watersheds of agricultural regions of Ontario T. Sultana, Trent University / Environmental and Resource Studies; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre

This study proposes to identify the origin of 30 polyhalogenated acic acids (PFAS = 4.6-501.7 ng.L$^{-1}$) but also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO304
Herbicides and fungicides in wastewaters of agricultural regions of Ontario T. Sultana, Trent University / Environmental and Resource Studies; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre

The objective of this project was to evaluate the distribution of selected current-use fungicides and herbicides in 5 major rivers and 13 smaller streams within regions of intense agriculture in southern Ontario, Canada. The Polar Organic Chemical Integrative Sampler (POCIS) was selected as a principal monitoring technique, although grab samples of surface waters were also collected throughout the POCIS deployment periods. The sampling rate ($R_s$), for each target compound was determined in the laboratory with synthetic water over 14 days at 15°C. The sampling rates were adjusted for the influence of environmental factors (e.g. temperature, flow) by measuring the loss of Performance Reference Compounds (PRCs) spiked into POCIS deployed in the field. Extracts from POCIS and grab samples were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS). In order to model the effluent of Suyeong MS/MS). The results showed the presence of selected antibiotics and NFs in influent-effluent from WWTPs around the city of Rome and in contaminated sites along the urban stretch of Tiber and Aniene rivers. The results confirmed that WWTPs were the main source of river contamination. Although the effluent wastewater input into receiving water should produce a dilution of contamination, the continuous release of these xenobiotics into the aquatic environment may lead to chronic exposure of organisms at all levels of the food chain.
A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) absorbers in personal care products and synthetic textiles to protect them from direct sunlight. Following use, BPs can enter ambient environments directly via effluents (by direct discharge or indirectly from sewage discharges). Numerous studies have indicated that BPs can enter aquatic environments in a typical Mediterranean River Basin to determine accurately the presence and environmental hazard of psychoactive pharmaceuticals (MET, COD and EPH) were mostly detected in the sampled areas (mean of 4.67 ng/L, ranged from 2.34 to 7.21 ng/L) and BCG and MET were detected in a total of 8 and 7 sampling points, respectively, each one at a mean concentration of 14.02 (1.83–12.7) ng/L for BCG and 11.4 (2.29–40.1) ng/L for MET. GIS provided the spatial incidence of drugs of abuse along the Turia River Basin. The occurrence of these psychoactive drugs could be correlated with the highest population densities, according to the descriptive model of territorial presence. Compounds used as drugs of abuse and prescribed as pharmaceuticals (MET, COD and EPH) were mostly detected in Valencia city and its metropolitan area where most hospitals are located. Although risk assessment showed low ecotoxicological hazard, further studies are also needed in order to assess long term toxicity.

MO308 Occurrence, fate and environmental risk assessment of benzophenone-type UV filters in a tropical urban watershed
K. Gin, National University of Singapore / Civil & Environmental Engineering; F. Mao, National University of Singapore / Civil and Environmental Engineering; L. You, National University of Singapore; M. Reinhard, Stanford University; Y. He, Shanghai Jiao Tong University
A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) light absorbers in personal care products and synthetic textiles that are exposed to sunlight. Following use, BPs can enter ambient environments directly via recreational activities or indirectly from sewage discharges. Numerous studies have been conducted to detect the occurrence of BPs in the aquatic environments. However, the occurrence and fate of BPs in tropical waters remains poorly understood. In this study, occurrence and fate of seven BP-type UV filters (i.e., 2,4-dihydroxybenzophenone (BP-1), 2,2',4,4'-tetrahydroxybenzophenone (BP-2), 2-hydroxy-4-methoxybenzophenone (BP-3), 2,2'-dihydroxy-4,4'-dimethylbenzophenone (BP-6), 2,2'-dihydroxy-4-4'-methoxybenzophenone (BP-8), 4-hydroxybenzophenone (4OH-BP) and 4,4'-dihydroxybenzophenone (4DHB)) were investigated in a tropical urban watershed consisting of five major tributaries that discharge into a well-managed water body. The BPs concentrations were measured in four compartments, i.e., bulk water, suspended solids, pore water and sediments. Results showed that benzophenone concentrations varied from widely < LOQ to 122.6 ng L\(^{-1}\) in dissolved phase and < LOQ to 2774 ng L\(^{-1}\) in solid phases. Suspended solids in the water column contained significantly higher amounts of BPs than sediments, while the concentration difference between bulk water and pore water was insignificant. Further study will evaluate the vertical concentration profile in the aqueous phases and in the solid phases. The concentration ratio of BP-1 to BP-3 will also be addressed, aiming at evaluating the degradation of BP-3 in the field. This will be followed by a preliminary risk assessment.

MO309 Formation of disinfection byproducts through various drinking water treatment processes
C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; P. Emilianio, ATLL Concessoría de la Generalitat de Catalunya, SA; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry; F. Valero, ATLL Concessoría de la Generalitat de Catalunya, SA
This work investigates the formation of disinfection byproducts (DBPs) throughout the treatment processes operating in the various drinking water treatment and desalination plants and distribution system that supply drinking water to more than 4.5 M inhabitants living in the city of Barcelona and its metropolitan area. For this, DBP formation potential tests with chlorine were performed with the water entering each plant and produced after the individual processes carried out in each plant to treat the water. DBP mixtures were generated for each investigated matrix at two different temperatures (15°C and 25°C) and reaction times (0, 24, 48, 56, 72 h, and 72 h in the plant effluent) so that different scenarios in the drinking water distribution network were simulated. Six different DBP classes in total were investigated in the DBP mixtures generated by means of gas chromatography coupled to mass spectrometry detection. The list included the regulated N-Nitrosamines (NDMA) and N-Nitrosodimethylamine (NDMA), trihalogenated ethylene glycol ethers (THEGs), trihalogenated methylene glycol ethers (THMEs), trihalogenated 1,2-dichloroethane (TDE), halogenated acetylureas (HANS), halogenated acetamides (HACAs) and halocetic acids (HAAAs). Overall it could be concluded that the potential of the water entering the plants to form all investigated DBPs decreased throughout the treatment process, due to the removal of DBP precursors in the different treatment steps. The work performed contributed to evaluate the risk associated with changes in the water treatment process and prevent population exposure to DBPs in the event of scenarios that may alter the good performance of the whole process. Acknowledgments: C.P. acknowledges support from the Secretary for Universities and Research of the Ministry of Economy and Knowledge of the Government of Catalonia and the COFUND Programme of the Marie Curie Actions of the EU’s FP7 (2014 BP. BO0006). This work has been financially supported by the Government of Catalonia (Consolidated Research Groups 2014 SGR 418-Water and Soil Quality Unit and 2014 SGR 291-ICRA).

MO310 Formation of N-nitrosodimethylamine during water treatment for potable use: an update
B. G. Slencu, University of Medicine and Pharmacy Grigore T. Popa Iasi / School of Pharmacy; L. Avasăciă, I.D. Moraru, Grigore T Popa University of Medicine and Pharmacy of Iasi / School of Pharmacy
Nitrosamines can form in water in specific conditions. N-nitrosodimethylamine (NDMA) is formed in drinking water that has been chlorinated with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonation or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between nitrosamine or dichloramine and secondary amines; b) reaction of typical secondary amine precursors; c) chlorination of nitrite in the presence of nitrosamine precursors; d) catalytic formation on activated carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines. Many organic nitrogenous substances can be NDMA precursors (pharmaceuticals, substances used in cosmetics, pesticides, chelating agents, amine-based polymers, etc.), but not all can be present in significant amounts in the source water. In the context of water treatment for potable use, amine-containing coagulants and some anion exchange resins constitute the main source of NDMA precursors. Although NDMA is the most widely detected N-nitrosamine in drinking water which was subjected to chloramination. NDMA is also found in water subjected to disinfection with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonation or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between nitrosamine or dichloramine and secondary amines; b) reaction of typical secondary amine precursors; c) chlorination of nitrite in the presence of nitrosamine precursors; d) catalytic formation on activated carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines. Many organic nitrogenous substances can be NDMA precursors (pharmaceuticals, substances used in cosmetics, pesticides, chelating agents, amine-based polymers, etc.), but not all can be present in significant amounts in the source water. In the context of water treatment for potable use, amine-containing coagulants and some anion exchange resins constitute the main source of NDMA precursors. Although NDMA is the most widely detected nitrosamine in drinking water which was subjected to chloramination. NDMA is also found in water subjected to disinfection with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonation or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between nitrosamine or dichloramine and secondary amines; b) reaction of typical secondary amine precursors; c) chlorination of nitrite in the presence of nitrosamine precursors; d) catalytic formation on activated carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines. Many organic nitrogenous substances can be NDMA precursors (pharmaceuticals, substances used in cosmetics, pesticides, chelating agents, amine-based polymers, etc.), but not all can be present in significant amounts in the source water. In the context of water treatment for potable use, amine-containing coagulants and some anion exchange resins constitute the main source of NDMA precursors. Although NDMA is the most widely detected nitrosamine in drinking water which was subjected to chloramination. NDMA is also found in water subjected to disinfection with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonation or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between nitrosamine or dichloramine and secondary amines; b) reaction of typical secondary amine precursors; c) chlorination of nitrite in the presence of nitrosamine precursors; d) catalytic formation on activated carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines.
Toxicology and Risk Assessment TAYER / Rey Juan Carlos University
Historically, coastal and transition waters have preferentially been used for human settlement, leading to a continuous input of wastewater effluents into these habitats. Water quality monitoring of these systems, with the goal of improving their protection under the water framework directive is highly needed. The number of studies characterizing the presence of psychoactive pharmaceuticals (PAs) in coastal waters and marine biota (fish, mussels, etc.) has increased. Our work represents the first attended at these toxic compounds in the Rias Baixas area (North Western Spain). This area was chosen as the location for this study due to its economic and ecological importance as a national and global leader in shellfish (especially mussels) production. In this study, the presence of 16 PAs (benzodiazepines and anxiolytics) was studied in samples of sea water and tissue from 7 economically valuable and highly consumed marine species. Samples were collected from 22 sites along the three main Rias Baixas. Fourteen out of the 16 assessed substances were detected in the water samples with venlafaxine (64%) and citalopram (41%) showing the highest detection frequencies. The highest concentrations in water were also measured for venlafaxine (291 ng/L), followed by lorazepam (95.90 ng/L) and citalopram (92.50 ng/L). Only 3 PAs (alprazolam, chlorpromazine and venlafaxine) were present in the collected biota samples (raspberry claw, clam, clam and octopus) in concentrations up to 14 ng/g d.w. (citalopram), 3 ng/g d.w. (venlafaxine) and 0.31 ng/g d.w. (alprazolam). Hazard quotients (HQ), calculated from the measured concentrations in water and available chronic aquatic toxicity data resulted in values higher than 1 (indicating elevated hazard and possible risk) for venlafaxine, citalopram, and sertraline. The venlafaxine contained in glycophosphate and AMPA fish bile from the Marne River, France H. Blanchoud, EPHE UMR 7619; T. Ferreux, F. Alliot, EPHE / UMR Metis; A. Gouze, UMR METIS EPHE Glycophosphate is a widely used herbicide. In France, it is used during intercultural operations and to control weeds in non-agricultural areas. Glycophosphate and AMPA (its main degradation product) can reach high concentrations in rivers, especially in the Seine basin including the Paris suburb (France). Although it is not bioaccumulative, the associated use of surfactants in pesticide formulations allows better assimilation in biological tissues. The aim of our study was first to develop a method to assess glycophosphate and AMPA levels in biological tissues and then to determine the contamination of a freshwater fish, the European club (Squalius cephalus) and a common fish from a tributary of the Seine River (Squalius cephalus) at 4 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized fish and frozen for further analysis. Then, 100μL of bile was taken in a digestion vial 100μL of 60% H2SO4 and 13C-AMP A (500μL) added before extraction with nullIQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC-Cl) and concentrated on SPE OASIS HLB cartridge (60cc) before LC MS MS analysis. Preliminary tests were performed to establish and validate the protocol and to find the lowest limit of quantification and the best reproducibility. Results showed that glycophosate is detected in a fish sample coming from the most contaminated site by AMPA. This suggests that glycophosphate is assimilated in fish and is still detectable after glycophosphate has been degraded to AMPA in the water river. Glycophosphate content in fish could be an indicator of environmental contamination. Further developments are needed to validate the protocol and complete the study with other organisms and bile.

M0312 Detection of glycophosphate and AMPA in fish bile from the Marne River, France

M0313 From source to food: following emerging pollutants A. Garduno, The University of Nottingham; S. Pathasarathy, The University of Nottingham / Faculty of Engineering; J. Duran-Alvarez, Universidad Nacional Autonoma de Mexico / CCADET; C. Orton, D. Barrett, The University of Nottingham / Faculty of Science; T.P. Dodsworth, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering
The current global population growth is putting an increasing strain on the world’s natural resources. Given this context, it is relevant not only to evaluate the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, it is relevant not only to determine the concentrations of these compounds but also their bioaccumulation potential. In this context, the objective of this work was to investigate the occurrence of different classes of psychoactive substances and metabolites in mussel tissues, and to assess the bioaccumulation potential of these compounds in these organisms. To this end, an analytical method based on a “quick, easy, cheap, effective, rugged, safe” (QeUCeRS) extraction and subsequent determination by means of liquid chromatography-electrospray–tandem mass spectrometry (LC–ESI–MS/MS) was developed and validated for analysis of over 40 psychoactive compounds and metabolites, including various illicit drugs (opioids, amphetamine-type stimulants, cocaine, cannabinoids, and hallucinogens) and therapeutic drugs (anxiolytics, antidepressants, sedative/hypnotics and stimulants) in mussels. This relatively fast and simple methodology allowed the quantification of most of the target analytes at the low ng/mL level. Poor analyte absolute recoveries, which could be attributed to ionization suppression effects by matrix components, were obtained especially for cannabinoids. However, analyte losses and matrix effects are satisfactorily compensated by the use of deuterated analogues as surrogate internal standards. Finally, fish bile from the Seine basin including the Paris suburb was analyzed as an indicator of environmental contamination. Further developments are needed to ensure the method can be used for the determination of other psychoactive substances in mussel tissues and aquatic organisms.

New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (P)

M0315 MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis. First development steps and future perspectives A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, G. Gerds, Alfred Wegener Institute / Shelf Sea Environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from source (irrigation water), through soil and finally in plant tissue. Therefore this paper presents a method to analyse the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

T.P. Dodsworth, EPHE / UMR Metis; A. Gouze, UMR METIS EPHE
Determination of glycophosphate and AMPA in fish bile from the Marne River, France

From source to food: following emerging pollutants

A. Garduno, The University of Nottingham; S. Pathasarathy, The University of Nottingham / Faculty of Engineering; J. Duran-Alvarez, Universidad Nacional Autonoma de Mexico / CCADET; C. Orton, D. Barrett, The University of Nottingham / Faculty of Science; T.P. Dodsworth, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering
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M0314 Psychoactive compounds in mussels: analytical method development and occurrence assessment

It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, it is relevant not only to determine the concentrations of these compounds but also their bioaccumulation potential. In this context, the objective of this work was to investigate the occurrence of different classes of psychoactive substances and metabolites in mussel tissues, and to assess the bioaccumulation potential of these compounds in these organisms. To this end, an analytical method based on a “quick, easy, cheap, effective, rugged, safe” (QeUCeRS) extraction and subsequent determination by means of liquid chromatography-electrospray–tandem mass spectrometry (LC–ESI–MS/MS) was developed and validated for analysis of over 40 psychoactive compounds and metabolites, including various illicit drugs (opioids, amphetamine-type stimulants, cocaine, cannabinoids, and hallucinogens) and therapeutic drugs (anxiolytics, antidepressants, sedative/hypnotics and stimulants) in mussels. This relatively fast and simple methodology allowed the quantification of most of the target analytes at the low ng/mL level. Poor analyte absolute recoveries, which could be attributed to ionization suppression effects by matrix components, were obtained especially for cannabinoids. However, analyte losses and matrix effects are satisfactorily compensated by the use of deuterated analogues as surrogate internal standards. Finally, fish bile from the Seine basin including the Paris suburb was analyzed as an indicator of environmental contamination. Further developments are needed to ensure the method can be used for the determination of other psychoactive substances in mussel tissues and aquatic organisms.

New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (P)

M0315 MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis. First development steps and future perspectives

A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, G. Gerds, Alfred Wegener Institute / Shelf Sea Environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from source (irrigation water), through soil and finally in plant tissue. Therefore this paper presents a method to analyse the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

T.P. Dodsworth, EPHE / UMR Metis; A. Gouze, UMR METIS EPHE
Determination of glycophosphate and AMPA in fish bile from the Marne River, France
thousands of reference spectra in one run, is written in RAD Studio (Embarcadero Delphi IDE), an object-oriented programming environment which allows easy construction of user-friendly interfaces. As an example, an imaging dataset of 196 tiles from a 128x128 pixel FPA detector (totaling 3.2 million individual spectra) can be easily managed using the software’s features. The software calculates the Pearson’s correlation coefficient between the unknown spectra and a reference spectral library. In addition, the software is further refined to define particle boundaries. Potential MP can then be marked, measured (main axes, area) and saved. MPHunter is open source freeware. It allows a semi-automated MP identification and quantification, decreasing the time demand for the interpretation of FTIR-imaging data and increasing the data accuracy. Further improvements are ongoing to interface MPHunter to the Analysis Pipeline from Primpke et al. (2017) and use it as the searching engine.

MO316
From alpine regions to dense populated areas: A comparison of microplastic contamination between 15 rivers across Germany
Among marine litter, plastic waste is of growing concern, as nowadays it has become ubiquitous in the oceans. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies also reported on the contamination of freshwater ecosystems with microplastics. Therefore, freshwater ecosystems do not only act as a source of plastic particles for the oceans, they also act, at least temporarily, as a sink. This may come along with all the associated harmful consequences that have been reported previously for marine ecosystems. Nevertheless, there is a considerable gap of knowledge about the impact and contamination of freshwater ecosystems with plastic particles. The lack of harmonized methods for microplastics sampling and detection hamper the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently being performed at the JPI Oceans for DAABMAN. Results show a high variability between rivers and due to the lower size fraction measured relatively high concentrations compared to the few studies conducted in surface waters of freshwater ecosystems so far. Further, our data may shed light on major pathways and sources of microplastics in freshwater ecosystems. (M. Loeder, I. Schrank and H. Imhof contributed equally to the work as first co-authors).

MO317
Analytical approach for the identification and quantification of microplastic particles in environment samples by particle analysis in combination with FTIR and Raman microscopy
D. Frecheg, Leibniz-Institut f. Polymerforschung Dresden / Analytik; A. Kaeppler, I. Muche, K. Eichhorn, Leibniz Institute of Polymer Research Dresden; S. Oberbeckmann, Leibniz Institute of Baltic Sea Research Warnemuende; M. Labrenz, Leibniz Institute of Baltic Research Warnemuende
The detection of microplastic particles in an environment sample in the wide range from 1 µm to 5 mm nearly quantitatively in a reasonable time is a challenging matter. This task is handled with well-defined sampling procedures and sampling locations. Next task is the sample preparation procedure to remove organic and inorganic parts in such a manner, that the microplastic particles will not be destroyed. A further important point is the subsequent loss free transport to an analytical lab and the use of blind samples from the sampling location through all steps until the lab. Starting from this point our poster describes the following practical steps to identify the microplastic particles in environment samples. All operations and analyses are performed in dust-free rooms in flow boxes and all equipment is plastic-free. First procedure is a three-step vacuum filtration to divide the particles in four fractions, above 500 µm, from 500 to 50 µm, from 50 to 10 µm and below 10 µm. After filtration the particles of the different fractions are on silicon filters made from wafers which are IR transparent. Now the particle identification programs determine all particles in shape and dimension and store there coordinates for the subsequent measurements with FTIR and Raman microscopy. Both methods identify the microplastic particles on the filter by their chemical structure using spectral databases. This spectral search runs automatically. The databases include polymers, copolymers, fillers, inorganic and organic substances, paints and lacquers. The IR libraries use transmission, ATR and reflection spectra and the Raman libraries use spectra measured with 532, 633 and 785 nm lasers. Every particle is assigned about the spectrum to a substance. This can be a polymer or in case of a mixed spectrum a polymer with paint/filler or also not a polymer. The fractions above 500 µm and from 500 to 50 µm are measured mainly with FTIR and the fraction from 50 to 10 µm and some selected samples below 10 µm mainly by Raman. However, several samples of the fractions above 10 µm are measured also with both methods since a combination of both delivers complete microplastic particles analysis. Further parameters, as the integration time, the number of accumulations, the magnification of the objectives and the lateral resolution, which influence the results concerning measurement time and locating and identification of mainly smaller particles will be discussed.

MO318
Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics
T. Storseth, L. Sorensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Høyes, Norwegian University of Science and Technology; O. Brakstad, A. Booth, SINTEF Ocean / Environmental Technology
Pyrolysis gas chromatography coupled to mass spectrometry (pyGC-MS) is a promising tool for identifying and quantifying trace amounts of microplastic (MP) in environmental samples. For pristine plastic samples, it has been demonstrated that polymer type and additive chemicals can be elucidated from the obtained pyrograms and their underlying mass spectra. In this study, an automated method for MP classification was developed. Pyrograms obtained from environmental samples are typically complicated by the presence of naturally occurring organic compounds and the presence of multiple polymer types. Furthermore, weathering processes such as oxidation and biodegradation may alter the chemical composition of the polymers, especially at the surface. Therefore, a untargeted analysis approach was first used to classify pristine and environmental MP samples. Multivariate tools were then applied to classify the samples based on the global pyGC-MS derived composition of the polymers, and to compare pristine materials with samples from the environment. The technique shows promise where manual techniques fail or have difficulty due to the lack of visual resolution of chromatographic peaks with important diagnostic mass spectral features. K. S. Storseth, K. Almaas, SINTEF Ocean / Environmental Technology

MO319
Marine Microplastic: Production and characterisation of realistic test materials for studying ecosystem impacts
Reported studies investigating the possible effects of plastic litter on marine biota have shown that plastic litter has almost exclusively utilised pristine plastic materials that are homogeneous in polymer type, shape, size and composition. Therefore, it is possible that microplastics (marine litter < 5mm), as collecting samples of such material from the marine environment in quantities sufficient for use in laboratory studies is simply not feasible. Crucially, weathered plastics collected from the marine environment show considerable physical and chemical differences to pristine and post-production consumer plastics. In the current study, we describe the preparation and characterisation of a more environmentally realistic marine litter-derived microplastic reference material (≤3 mm) for use in fate and effects studies. Weathered marine plastic litter (351 items) was collected from the coast of the island of Texel (The Netherlands) and carefully identified and categorised (fibre-based, packaging, foam, plastic boxes and jerry cans, bottles, gloves and miscellaneous plastic materials). The size and shape of the fractions are presented as the percentage of the collected material, which contained 9 different polymer types. The macroplastic material was sub-sampled and subjected to a cryo-milling and sieving process to create the microplastic reference material. To confirm that the original macroplastic polymer distribution was mirrored in the generated microplastic sample, it was subjected to ATR-FTIR and differential scanning calorimetry analysis. Particle size distribution (PSD) of the microplastics and particle composition analysis showed that 68% (by mass) of the particles were in the range between 0.5 and 2.0 mm. Particle number increased with decreasing particle size fraction. Scanning electron microscopy revealed a wide range of particle sizes and shapes reflecting the properties of the different polymers. ICP-MS and ICP-OES analyses revealed the presence of a broad range of metals and other elements (e.g. Al, Cr, Fe, Mg, Pb, S and Zn) associated with the final sample. Many of these represent common inorganic plastic additives used as colourants, fillers and stabilisers. The additive organic chemical profile of the macroplastic mixture was also determined by GC-MS analysis following extraction by ethyl acetate and ultrasonication. A broad
MO320 Optimization of the preparation of standards of high density polyethylene microplastics and quantification techniques by stereo and confocal microscopy.
J. Sanchez nieva, University; J. Perales, CACYTMAR University of Cadiz / Department of Environmental Technologies; E. Rojo-Nieto, Helmholzt centre for environmental research - UFZ / Department of Cell Toxicology; J. Gonzalez-Leal, University of Cadiz
A non-complex procedure has been developed for preparing HDPE microparticles as standard for microplastic determination in sediments. Always keeping environmental relevance in mind, different bottle caps from several brands were studied in order to identify those that could provide a clear spectrum for HDPE using Raman spectroscopy (considering that Raman spectroscopy is sensitive to those additive and pigment chemicals in microplastics that interfere with the identification of polymer types). Red caps from a popular brand of mineral water were selected as the raw material as their spectrum was easily comparable with those provided in the literature for HDPE. The large pieces of plastics were converted into microplastics by using a conventional machining process, i.e., a drill with a sandpaper implement (Dremel 300, 13 mm-60 grain size sandpaper). For this purpose, several sequential sessions of the machining processes were carried out in order to avoid changes in the physical properties of the plastics that would result from temperature increase due to due to prolonged friction. After the machining, the obtained HPDE particles were sieved using ethanol (96%) through two different mesh sizes until a final standard ranging from 0.1 to 0.850 mm size was achieved. This range was selected as it is relevant in biota ingestion risk as well as is appropriate for visual counting using microscopes. The standard HDPE microplastics used in all the extraction experiments were the same. It was thoroughly mixed previously to spiking in order to avoid differences in the distribution. To prepare a standard HPDE microplastics were suspended in ethanol 96% and shook using a magnetic stirrer. An effective method for determining the particle distribution of microplastics is microscopy. In this work, two types of quantification using microscopy were used and compared; optical microscopy by visual sorting (Leica ICC50 HD, 4x lens, using a mesh for counting with sections of 3x3 mm prepared for this study) and, confocal microscopy (Zeta Instruments, model Zeta 300). The last one, included object detection algorithms (Mathematica 10) which not only allows quantification of plastic particles but also their classification into size groups.

MO321 First Report of Microplastics in Pacific-side Arctic Ocean
H. Lee, S. Kim, Incheon National University / Department of Marine Science; S. Kang, Korea Polar Research Institute / Division of Polar Ocean Science
The Arctic is one of the pristine areas that are sensitive to global environmental changes and have a relatively low environmental pollution. However, Arctic is already affected by floating microplastics (MPs) according to previous studies (38-234 pieces/m² of sea ice and 83.43 pieces/m² in the Atlantic arctic pole water). Previous research on the Arctic has concentrated on the waters associated with the Atlantic Ocean (for example, the Barent Sea), while the Arctic Sea (e.g., the Chukchi sea, East Siberian sea, etc.) linked to the Bering strait has never been studied. This area can be particularly important because it links Asian marginal seas and the Pacific Ocean, which is regarded as a global hot-pot of MPs input to the ocean. We conduct annual surveillance in every summer since 2016 using a Korean icebreaker (R/V ARAGON) to identify the presence, distribution, fate and effect of MPs in the Arctic Ocean connected with the Bering Sea. This is first result for the Pacific ocean-side polar region investigated in 2016 (Aug/05-21/2016) & 2017 (Aug./06-25/2017) Aragon Expeditions. Here, we present the results observed in some media including seawater (surface and subsurface water), sea-ice core, and snow. Seawater samples were collected by manta-trawl net (200 mm mesh, n=12) for surface water, bongo net (330 mm; n=16) for subsurface water, sea ice (n=27) by ice-core, and snow (n=6). MPs were detected in all samples with average concentrations of 0.41 n/m² (surface water in 2016), 0.55 n/m² (subsurface water in 2016), and 12.90 n/L (in sea-ice core). We are progressing the analysis for sea-ice core samples to gain fuller understanding of the data to be added for 2017. It is generally known that plastics are light and float, therefore they could be enriched on the water surface layer. However, MPs abundance observed in the bongo net (subsurface water) was similar to that of the manta nets (surface water), which can be a strong evidence of the possible sinking of MPs into the deep water of the Arctic Ocean. On the other hand, the sea ice’s contamination level was observed to be several tens of thousands higher than seawater. This indicates the necessity of finding the fate of MP in terrestrial environments. By determining the occurrence and fate of MP in terrestrial systems in the ongoing discussion about the general monitoring of plastic pathways in the environment this is a gap, because MP in terrestrial environments could also influence the quality of soil, but might be also relevant for the final transport of plastics into the aquatic environment, e.g. via erosion. In this regard, one critical point is the lack of harmonized or standardized protocols. The matrix of soils is usually more complex than the matrix of aqueous samples. For a first assessment of a potential exposure situation, the detection of plastic mass rather than the determination of specific plastic types is primary. The goal of this work is the development of a systematic protocol for sampling, sampling pre-treatment and analysis of MP in terrestrial samples, which ends up in a fast, quantitative method. Up to now, various studies about the analysis of MP at beaches, in marine sediment and along rivers are available. In these studies, as sample pre-treatment density separation techniques were used to reduce the inorganic matrix. In some cases, a chemical oxidation step to minimize the organic matrix is additionally carried out. FTIR or Raman spectroscopy were used to analyse the sample with enriched concentrations of MP. Using these techniques, only small proportions of inserted samples were analysed. Similar investigations techniques were used for terrestrial samples. The few existing studies investigated sewage sludge, compost fertilization or areas of intensive utilization of plastics foils in agriculture or from industries. At first, the goal for the present study was the development of a method to examine MP in terrestrial environments. We have improved our method to a fast, quantitative method. The next studies will be concerned with the determination of MPs in terrestrial samples and the determination of MPs in the environment. The results of this study can be applied to further study on the major origins & mass balance of MPs in the Arctic Ocean, and contribution of MPs to environmental changes in the Arctic Ocean.

MO322 Microplastics in Expanded Global Table Salt Product Samples and its implication
J. Kim, Incheon National University / Department of Marine Science; C. Kim, Graduate East Asia; S. Kim, Incheon National University / Department of Marine Science

Microplastic is becoming a global issue in marine environment pollution. Among the various environmental media, some recent studies have identified microplastic contamination that remains in salt (sea salt, lake salt, rock salt). As salt is an essential human/animal food-item, microplastic contamination in salt products could easily get into human beings (including foods). The goal of this study is to identify the contamination of microplastic in commercial table salt products sold worldwide, 2) to elucidate any relationship of microplastic contamination between sea-salt and sea-water and 3) to calculate the human exposure of microplastics resulting from the consumption of commercially available salt products. To do this, we purchased and analyzed the salt samples sold in 17 countries (8 countries in Asia, 7 in Europe, 1 in Africa and 1 in North America) for four continents. Each salt sample was selected in consideration of the salt production area, production method, and salt consumption rate. Total 37 salt samples were analyzed, including sea salt, lake salt, and rock salt. Each sample was dissolved (n = 2) and two blank samples were analyzed for each batch to check contamination during the analysis. Size, color, polymer, and shape of each microplastic was determined using microscopic and spectroscopic analysis (FTIR). Thousands of microplastics were detected per 1 kg of the salt samples of this study, and the predominant forms were fragment and fiber, which were frequently detected in the order of PP > PET > PS. Significant correlation was observed between microplastic discharge rate via the rivers near the sea-salt production and microplastic contamination in the sea-salt. After further analysis, human exposure, characteristics of microplastic distribution, and application of sea-salt as an alternative monitoring medium will be announced.

MO324 Biodegradability of pristine and weathered car tire rubber using different inocula
F. Poleses, Technical University of Denmark (DTU) / DTU Environment; T. Ahonen, Technical University of Denmark (DTU) / DTU Environment
Car tire wear is estimated to represent a major fraction of microplastic pollution in the environment. Rubber particles are transported by road transport and wind run-off, thereby reaching soils and wastewater treatment systems. Information on their occurrence, fate and degradability in environmental and engineered systems is limited yet crucial to determine their persistence and potential risks associated to their exposure. In this study, we assessed the biodegradability of car tire rubber (90-125 µm) under controlled laboratory-scale conditions. Standardized batch tests (OECD 301 and ISO 14851) were used to determine complete mineralization under...

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aerobic conditions of pristine and UV-weathered tire rubber in the presence of three different microbial inocula, i.e. activated sludge, soil particles and soil supernatant. Acetate and poly(D,L-lactide-co-glycolide) (PLGA) were used as positive controls in terms of readily degradable substrate and degradable plastic material, respectively. Pristine and weathered rubber exhibited low but measurable biodegradation levels in the presence of activated sludge (3.8 – 7.6% THOD) and soil supernatant (3.4 – 7.5% THOD) while no biodegradation was observed when using soil particles as inoculum. Accelerated UV weathering and higher biomass concentration was found to increase the biodegradability by activated sludge. Interestingly, increased response in terms of oxygen consumption was observed with acetate as co-substrate, indicating improved rubber degradability in the presence of a readily degradable carbon source. PLGA exhibited limited biodegradability and free formation of oxidizing elements on surfaces increased porosity and roughness on rubber surfaces over the course of the experiments, seemingly indicating degradation via surface colonization. Overall, ready biodegradability tests proved suitable to obtain information on degradation of car tire rubber. This study provides first evidence of their degradability, especially for weathered rubber in the presence of a co-substrate, which should be considered for future work. Future work should consider longer durations, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

**MO325**
Evaluating sorption properties of tire materials using poly-parameter linear free-energy relationships (ppLEERs)
M. Weihrhan, University of Vienna / Environmental Geosciences; T. Huffer, T. Hofmann, University of Vienna / Department of Environmental Geosciences
Tire materials are common representatives of microplastics in the environment, which they reach via road runoff. 1. On the other hand recycled and shredded tire rubber (TCR) is applied as filler material for example on turf. It was recently shown that tire materials are a substantial share (66%) on waste that is introduced into the environment as microplastic particles. 2. Tires generally consist of a mixture of polymers (40-60%), mostly styrene butadiene rubber (SBR). These elastomers are compounded with carbon black or silica as reinforcing agent (20-35%), oils (15-20%) as softeners and extenders as well as vulcanization chemicals (e.g. zinc oxide and sulphur (1-2%). 3. Although tire materials are known to pose the risk of leaching toxic substances, they are one of the most popular construction materials and are widely distributed for example in the application of artificial materials or recycled rubber on the organic pollutants from water. 4. The precise characterization of molecular interactions between tire materials and (organic) compounds is therefore important to evaluate and predict the behaviour of tire materials in aqueous systems. Poly-parameter linear free-energy relationships (ppLEERs) provide the opportunity to describe the contributions of individual molecular interactions to overall sorption processes taking into account both the physico-chemical properties of the sorbate as well as the sorbent. 5. They have been successfully used to describe and predict sorption of organic compounds to various sorbents. 6. This work hence intends to investigate sorption properties of tire rubber using poly-parameter linear-free energy relationships. [1] B. Liebmann, Mikroplastik in der Umwelt, 2015. [2] B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo, Sci. Total Environ. 2009, 407, 2183. [3] C. Lavoine, Microplastics: Occurrence, Effects and Sources of Releases, 2015. [4] Y. R. Lin and H. Teng, Microporous Mesoporous Mater. 2002, 54, 167. [5] R. B. Stone, L. C. Coston, D. E. Hoss, F. Cross, Mar. Fish. Rev. 1975, 37, 18. [6] L. Alamo-Nole, O. Perales-Perez, F. R. Roman, Desalin. Water Treat. 2012, 49, 296. [7] M. Abraham, A. Ibrahim, A. Zissimos, J Chromatogr A. 2009, 1237, 29. [8] S. Endo, P. Gratwohl, S. Haderlein, T. Schmidt, Environ Sci Technol. 2009, 43, 3094.

**MO326**
Particle toxicity in the daggerblade grass shrimp (Palaemonetes paludosus) microwinged tire wear particles and microplastics
L. L. Halle, Department of Biology; R. Leads, College of Charleston / Biology; S. Kell, College of Charleston / Graduate Program in Marine Biology; A. T. Tew, University of North Carolina at Greensboro / Biology
Recent surveys of Charleston Harbor, SC (USA) have demonstrated that >75% of total microplastics at some locations are tire wear particles (TWP). The aim of the present study was to investigate the toxicity of wet prepared TWP in adult grass shrimp (Palaemonetes paludosus) and compare it to that of other microplastic particles. For our TWP assays, we conducted a 96-hour acute toxicity test and an immune challenge. Acute mortality was not observed at concentrations up to 100 g/L (1.9x10^7 particles/L). In our immune challenge, grass shrimp were exposed to TWP, polypropylene fragments, polystyrene spheres, polyether fibers, or sediment for 96-hours. Grass shrimp were then injected with either HEPEX-buffered saline or V. campbellii (1x10^3 CFU/shrimp). After 48-hours, no significant decrease in immune function was observed in exposed shrimp (p=0.8). We also conducted assays examining the size and shape dependent effects of microplastic particles (spheres, fibers and fragments), including TWP, on grass shrimp. Grass shrimp were initially exposed to various size fractions of plastic spheres (30, 35, 59, 75, 83, 116, and 165 µm), fragments (34 and 93 µm), fibers (34 and 93 µm) and TWP (50, 106, and 302 µm) at a concentration of 50,000 particles/L for three hours. Following exposure, grass shrimp were placed in particle-free water and monitored for survival, ingested and ventilated particles, and residence time in the gills and gut. Grass shrimp readily ingested and ventilated all tested particles. The time for mortality to be >90% of the control was >2 hours. Gut clearance for the TWP was 92%±5.3%. With TWP, grass shrimp were then injected with either HEPES-buffered saline or V. campbellii (5x10^3 CFU/shrimp) and monitored for survival, ingested and ventilated particles, and residence time in the gills and gut. Grass shrimp readily ingested and ventilated all tested particles. The time for mortality to be >90% of the control was >2 hours. Gut clearance for the TWP was 92%±5.3%.

**MO327**
Acute and chronic toxicity of microwinged tire rubber to Hyalella azteca
F. Khan, L. L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment
An average car tire lasts for 40,000 km and during its life time 30% of the tire tread will emitted into the aquatic environment. Inevitably it interacts with aquatic biota. In comparison to the wealth of research on the impacts of microplastics (MPs), there is little on microwinged tire rubber (microwrubber, MR). Recent reports suggested that tire rubber contributes a significant proportion of ocean’s plastic and when rubber is found in the environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHs), the biocide copper (Cu) and assorted volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aquatic environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceived to determine the toxicity of tire rubber particles to Hyalella azteca, an established freshwater model organism, over acute and chronic exposure periods, and to delineate particle effects from those of the leachate. The acute toxicity (48 h) of MR particles compared to the MR leachate show similar LC50s (3426±172 particles/mL for MR and 3628±672 particles/mL for leachate), but significant differences are found at LC10 and LC90, suggesting that at low particle concentration the leachate is more important, but at high concentrations the particle may act to deliver chemicals in vivo following ingestion. The results of the 21 day study showed that mortality, reproductive output (neonate production) and net growth were significantly impacted at the higher exposure concentrations of MR. MR is an emergent contaminant of concern that is similar but distinct to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

**MO328**
Acute and chronic effects on Hyalella azteca and chemical analysis of rubber particles and leachate - comparison of pristine microwinged car tire to previous data on worn car tire particles
L. L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; R. Kumpmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment
Microwrubber (MR) from car tires constitutes a significant contribution to particulate contamination of the aquatic environment. MR is produced from driving, in the interface between tires and asphalt, and may eventually be lead out to the surface waters, possibly together with leached granulated rubber particles used in artificial turf. Although rubber particles have been detected in the aquatic environment the potential environmental impacts of this contamination are largely unknown. Hyalella azteca is an ecologically relevant freshwater amphipod that is also a well-established model organism in ecotoxicology. This study aims to investigate the acute and chronic effects of MR particles on Hyalella azteca, and to measure the effects and chemical characteristics of a pristine tire with previous data from a worn tire of same make and model. Effects are assessed as changes in survival, growth and reproduction and both the effects of rubber particles and rubber leachate is investigated with the aim of determining whether there are particle effects and/or if the mode up take of chemicals leached from tire influences effects observed in this test system. The chemical characteristics of both pristine and worn tire particles are quantified by GCMS. The preliminary results indicate that, surprisingly, pristine tire both as particles and leachate is much more toxic than worn tire in acute tests. Although the main source of MR undoubtedly is worn tire, these results points toward further ecotoxicological testing of tire coatings used during manufacturing. Results from this ongoing study will be presented and discussed in relation to the microwrubber debate.

**MO329**
Applying nuclear techniques to study the biokinetics and toxicodynamics of...
microplastics and co-contaminants in marine biota
C. Lancot, International Atomic Energy Agency / Radioecology Lab; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; A.J. Catarino, Heriot-Watt University / Institute of Life and Earth Sciences; T. Cresswell, ANSTO Environmental Research / Institute for Environmental Research; B. Danis, Université Libre de Bruxelles; T. Mincer, Woods Hole Oceanographic Institution; F. Oberhaensli, P. Swarzenski, International Atomic Energy Agency / Radiological Lab; I. Tolosa, International Atomic Energy Agency; H.K. Karapanagioti, University of Patras / Chemistry Department; M. Metian, IAEA-EL / Radioecology Lab

Despite recent efforts in understanding the risks associated with marine plastic pollution, there remains a great deal of uncertainty regarding the potential impacts of their degradation on wildlife and humans. This largely relates to the methodological and analytical limitations associated with studying relatively low and environmental concentrations of these plastics. The IAEA Radioecology Laboratory, in collaboration with a team of external experts, is tackling these challenges by applying nuclear and isotopic techniques to address important outstanding questions on the risks of microplastics to marine organisms. Novel approaches using radiolabeled plastic particles and associated organic and inorganic contaminants are being developed to very precisely quantify their movement, fate and impacts on a range of aquatic biota, under controlled laboratory conditions. Nuclear techniques are uniquely suited for this research given their sensitivity and capacity to measure biokinetic and toxicodynamic parameters over time. As such, these tools will allow us to address important knowledge gaps, including (1) the biokinetics, biotransformations and their ecological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminants, particularly in aquatic environments. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO330 Aggregation kinetics of plastic nanoparticles in fresh and marine phytoplankton culture media
J. venel, EPOC, University of Bordeaux / UMR EPOC 5805; J. Gigault, University of Rennes 1 / Laboratoire Geosciences Rennes; M. Baudrimont, Université Bordeaux 1 / UMR EPOC 5805

Release of plastics debris in the environment has been catching more and more concern in recent years, especially in aquatic environments. It has been observed recently, that plastics break down to produce nanoparticles by photochemical degradation in marine waters. However, there is a lack of suitable analytical tools, and the environmental fate and transport mechanisms of nanoparticles have not yet been investigated. Indeed, several ecotoxicology studies investigate the impact of nanoparticles on aquatic organisms without addressing their aggregation state in aqueous media, whereas (1) the biokinetics, biotransformations and their ecological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminants, particularly in aquatic environments. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO331 Influence of biofilm composition on mercury bioaccumulation

In aquatic systems, the dominant lifestyle of microorganisms (bacteria and microalgae) is to live together interlocked in exopolymeric substances (EPS), rather than as single cells. Besides their involvement in several biogeochemical processes, biofilms are sites of accumulation and transformations of mercury (Hg). Their natural assemblage of heterotroph and autotroph microorganisms makes them an important entry point of Hg into aquatic food webs. The objective of the present study is thus to better understand the mechanistic processes that control Hg accumulation in biofilms and we focused on the elucidation of the role of biofilm composition on the kinetics of Hg uptake. For that end, two couples of biofilms were exposed to IHg (~ 100 pM, precisely measured) using microcosms. The first couple of biofilms was obtained using different times of colonisation e.g. 85 and 127 days whereas the second couple (bottom/surface biofilms) was obtained owed to different colonisation depth in the Versoix River (CH). Prior Hg exposure, biofilm biomass and microbial composition (chlorophyll content and diversity of 16S rRNA gene) was determined as well as EPS chemical and metal EPS (Hg) content. The main water quality parameters (pH, concentrations of dissolved organic carbon, Hg, anion and cation) of the exposure media were also analysed. Accumulation of total Hg and non-extractable Hg (determined after a cystiene washing step) in biofilms were measured at different step times (t < 24 h) to model non-extractable Hg uptake kinetics using a non-linear pseudo first order one-compartment model. In each biofilm, non-extractable IHg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the younger biofilm was measured to be 10 times higher than that of the older biofilm. That same ratio was also obtained between the bottom and the surface biofilms. Except for the older biofilm, Hg accumulation reached a plateau at ~6 Hg exposure. A decrease in the EPS thiol concentration was observed in the bottom biofilm upon Hg exposure, suggesting a change in Hg bioavailability in the microorganism environment living in that biofilm. Our study demonstrated that biofilm microbial and EPS composition as well as thickness influence Hg uptake by microorganisms living in biofilms.

MO334 Gaseous elemental mercury concentration and diurnal evasional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea
S. Covelli, Dipartimento di Matematica e Geoscienze / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; F. Floreani, E. Petranich, E. Pavoni, University of Trieste

Among pollutants widespread in the environment, mercury (Hg) is of particular concern for its toxicity, mobility and bioavailability potential. In coastal areas then, the presence of this element generates conflicts with important resources of profitable value such as fisheries and aquaculture. The Marano and Grado Lagoon (Adriatic Sea) experienced a double Hg impact. The first is due to the mining activity conducted at Idrija (western Slovenia) for approximately 500 years, whereas the second is the result of discharge of a chlor-alkali plant effluents. Fish farming is a...
historical activity covering 14% of the total lagoon area. Recently, one fish farm was long-term monitored in order to understand the role of the sediment-water interface in recycling Hg and to estimate benthic fluxes and Hg mobility in the water column. An important further step toward a better comprehension of the Hg biogeochemical cycling in the lagoon environment, is represented by the estimate of its evasion fluxes, as gaseous elemental mercury (GEM), at the water-air interface. A dedicated instrument (Compact-GEM, Linnens-RCA 915+) has been used to measure GEM and to estimate the diurnal evasion flux at the water-air interface during three seasonal campaigns in four selected sites: two in a lagoon fish farm, one in the open lagoon environment highly impacted by Hg mining activities and the last one in an uncontaminated area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these monitoring through field-based campaigns, background GEM levels determined together with the main chemico-physical parameters influencing Hg behaviour.

This new insights will be of help for future estimates of Hg mass balance in one of the most contaminated areas in the Adriatic Sea. Keywords: atmospheric mercury; mercury fluxes; fish-farm; Grado Lagoon

MO335
Atmospheric mercury assessment: a contribution to global monitoring and effectiveness evaluation within the Minamata Convention

A. Fino, Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IAI); F. Spovieri, A. Macagnano, E. Zampetti, P. Papa, G. Esposito, CNR Institute of Atmospheric Pollution Research Italy; P. Nicola, Italian National Research Council - Department of Atmospheric Pollution Research (CNR-IAP) and WHO implemented a UN Environment Global Environmental Facility (GEF) project entitled “Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity for mercury analyses in human and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS)”. The main objective is to support the policy process in relation to the Minamata Convention Implementation. CNR-IAI proposed a selection of monitoring sites, mostly background sites but also including those highly impacted, to undertake passive sampling and analysis of Hg in ambient air in order to strengthen capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

MO336
Assessment of Hg impacts on mountain river ecosystems

S. Le Faucheur, Institute F.-A. Forel, University of Geneva / Département F.-A. Forel des sciences de l’environnement et de l’eau; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; C. Moreneau, Université de Genève; G. Daffe, University of Bordeaux / UMR EPOC CNRS 5805; A. Boullémat, RioTinto Mountain rivers are high-flow systems which can experience, even daily, high water height variations due to the presence of dams along their courses. These conditions limit the use of water and sediment analyses to identify pollution point sources; the capacity for mercury analyses in human and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS)”. The main objective is to support the policy process in relation to the Minamata Convention Implementation. CNR-IAI proposed a selection of monitoring sites, mostly background sites but also including those highly impacted, to undertake passive sampling and analysis of Hg in ambient air in order to strengthen capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

MO337
Mercury Photosolution and Total Photoreducible Mercury Dynamics in the Lakes of Keijmijuku National Park, Nova Scotia

N.J. O’Driscoll, Acadia University / Department of Earth and Environmental Science; T. Christensen, Acadia University / Biology; E. Verde, Nova Scotia Department of Natural Resources; S. Klapstein, E. Mann, Acadia University Photo-reduction and photo-oxidation are fundamental mechanisms controlling mercury volatilization and accumulation in freshwaters. In all surface waters dissolved gaseous mercury (DGM) is produced as a net result of the reduction of reducible mercury, which is believed to be primarily divalent mercury (Hg(II)) bound to specific carbohydrates and the oxidation of elemental mercury (Hg(0)). These two processes control the amount of DGM available for evasion across the water-air interface; however, determination of the fundamental rate constants and mechanisms of these reactions in freshwaters are still areas that require more research. In particular, the total amount of photoreducible mercury is emerging as a key variable that requires more exploration. Here, we review the present understanding of the photoreduction and oxidation over the last ten years. Analysis of rate constants as well as temporal dynamics in total reducible mercury derived from two recent projects that examined water samples from a series of freshwater lakes in Keijmikjuku National Park, Nova Scotia, Canada. We examined the hypothesis that gross photoreduction and photooxidation rates would be significantly different in lake water. Another hypothesis was that the amount of mercury available for reaction with solar radiation (i.e. reduction of Hg(II) to gaseous Hg(0)) in surface waters would significantly change over a summer. A Luzchem photo-reactor was used to irradiate 200 mL water samples in quartz beakers continuously exposed to ultraviolet radiation for 24 h with concurrent Hg(0) analysis to derive pseudo-first order gross reduction rate constants and batch experiments were used to derive net reduction rates (and gross oxidation rates by difference). Our study showed that the net photo-oxidation rates for freshwaters were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. This research provides the first quantitative measurements of gross photoreduction and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

MO338
Influence of Avian Biovectors on Mercury Speciation in a Wetland

J. Kickbush, Acadia University / Biology; M.L. Mallory, Acadia University / Biology; R. Leopold, Acadia University / Biology; J. Kickbush, Acadia University / Engineering; S. Klapstein, Acadia University / Earth & Environmental Science; A. Loder, Acadia University; N.M. Hill, Fern Hill; N.J. O’Driscoll, Acadia University / Department of Earth and Environmental Science.

Mercury is a persistent and bioaccumulative chemical that is present in many remote environments due to its ability to be transported long distances in the atmosphere, and to be deposited far from the original source (Sunderland and Chnura 2000). Wetland ecosystems are important “hot spots” for mercury in eastern Canada, providing anoxic environmental conditions that promote the bacterial methylation of mercury. Methyl mercury is the most biologically available form of mercury and the form which biomagnifies in food webs (Gochfeld 2003). Mercury can also be transported in gaseous form by avian biovectors – including mercury and nutrients, which may indirectly affect metal speciation (Choy et al. 2010). The site for this study, Big Meadow Bog (Brier Island, Nova Scotia, Canada) has a history of ditching in the 1950s, which changed hydrology significantly, resulting in colonization by 3000 pairs of herring gulls (Larus argentatus) in the 1980s. To quantify changes in mercury mobilization and speciation in response to this biovector activity, groundwater samples were collected. Results showed that the reference bog had similar geological and hydrological characteristics. The filtered samples were analyzed for total mercury, methyl mercury, and water chemistry (pH, conductivity, anions, cations, and dissolved organic and inorganic carbon). Results showed significantly higher nutrients (nitrate, phosphate, and sulfate), total mercury, and methyl mercury concentration when compared to the reference bog that is minimally impacted by avian biovectors. These elevated availability of methyl mercury could potentially pose a threat to the local ecosystem and wildlife population due to methyl mercury’s toxicity to living organisms (Akearok et al. 2010, Singh et al. 2011). Citations: Akearok J et al. 2010. Science of the Total
MO339 Organohalogen and mercury residues in fish from the Western Mediterranean Sea: concentrations, bioaccumulation and dietary exposure E. Junqués, Institute of Environmental Assessment and Water Research (IDAEA-CSIC); M. Gari, IDAEA-CSIC / Environmental Chemistry; R. Lull, General Direction of Public Health and Consumption; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry

Organochlorine compounds (OCs) and mercury (Hg) have diverse deleterious health effects and are persistent in the environment. They tend to bioaccumulate and biomagnify along the food chain. Diet is the major source for the incorporation of these pollutants into humans, especially through consumption of fish. This research focuses on the presence of OCs, total mercury (THg) and methylmercury (MeHg) in lean fish from the Western Mediterranean Sea. Determinant factors of these concentrations such as trophic level and weight of fish have been studied. The estimated weekly intake (EWI) from the Spanish population of these pollutants has been assessed. Samples were collected between March 2015 and August 2016. Most of them were from Balearic Islands (Majorca n=67, Menorca n=17, and Ibiza n=18) and the rest of the samples were from Tunisia (n=2) and Egypt (n=1). Additional fish samples were collected from the Atlantic Ocean, in front of Senegal (n=4) and Mauritania (n=10) coasts for comparison. The OCs levels found in fish were similar or lower than in other previous studies. In contrast, 15% of the most frequently fish species consumed by the Spanish population had Hg concentrations above the maximum level set forth by the European Union MRL for human consumption. The concentrations of OCs and Hg between trophic levels have been compared. Except for HgCB, the values were higher in the upper trophic level with statistically significant differences for ∑DDTs and ∑PCBs (p<0.05). The relationship between fish weight and pollutant concentrations were also studied. A positive relation between Hg concentrations and weight was found (R²=0.58; p-value<0.001). This trend was not observed for any other OC. The concentrations found in dusky grouper from the Mediterranean Sea and Atlantic Ocean were also compared. The former group presented higher levels for ∑DDTs, ∑PCBs and Hg (p<0.05). The estimated weekly intake of OCs were well below the reported Tolerable Intakes. However, for Spanish population that only consume Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the provisional tolerable weekly intake (PTWI) as set by EFSA in 2012, 4 µg/kg bw. The equivalent estimations for MeHg, involving provisional tolerable weekly intakes of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intakes in adults and children (7-12 years of age), respectively.


Fish consumption is linked to the prevention of some human diseases, especially respiratory disease and cardiovascular disorders, due to the content of high-quality protein, vitamins and n-3 fatty acids. At the same time, fish consumption is considered a major pathway of mercury (Hg) exposure in human. More than 90% of this Hg present in fish tissue is found essentially in its organic form (methylmercury (MeHg)), which is the most toxic form of Hg. Due to the potential adverse human health effects, international agencies have established Reference doses (RDI) as recommendations to Hg intake. Some studies have been associating the fish consumption with the Hg bioaccumulation, in areas along the Mid-Atlantic Ridge (MAR) exposed to active hydrothermal fields. The Azores archipelago is located in the North Atlantic Ocean close to the MAR. The last fishery statistics for fish consumption per capita in the Azores archipelago shows that, each Azorean consumes about 80 kg of fish per year being the region with the highest consumption of fishery products in Portugal. This study is the result of a review of all published articles indexed in Web of Science that presented Hg concentration in the muscle for fish species captured in the Azorean Exclusive Economic Zone, and additional new data from fish obtained by recreational fish. The selection of species was based on the fish landing reports (1994-2015) of Azores Fisheries Statistics (SIIAM) and the Azorean ports. At the about 10000 tonnes per year of these commercial fish species are discharged. Despite low Hg levels in fish, every year the population of this area is exposed to more than 1500g of Hg via fish consumption. However, the species with the highest concentration of Hg are not always those that contribute to a higher human exposure. The fish species Morula muro exhibit higher values than the permitted for fish consumption and carnivores fish species generally exhibit higher concentration of Hg than omnivores fish species. On the other hand, demersal fish species demonstrated higher Hg concentration than pelagic fish species. Finally, the target hazard quotient (THQ) is < 1 for all fish species, meaning that the level of exposure is lower than the reference dose, and indicating that the daily exposure is not likely to cause any negative health effects during a lifetime in the human population.

MO341 Mercury concentrations in black bread from the Gippsland Lakes, Victoria, Australia. L. Ma, EPA Victoria / EPA Victoria; S. Balshaw, Department of Health and Human Services; R. Goudey, EPA Victoria

The Gippsland Lakes are a coastal lakes system in eastern Victoria, Australia. They represent a unique aqueous ecosystem of significant ecological significance (Ramsar classified) as well as supporting significant tourism, recreational and commercial fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley to the east of the Lakes and wood smoke from household and planned burns. This study, conducted in 2015, aimed to determine if the concentrations in black bread in black bread had increased over time, and whether or not existing dietary advice issued nationally by Food Standards Australia New Zealand for the protection of consumer health against the effects of mercury in seafood, was appropriate for fish sourced from the Lakes. Three previous studies investigated the concentrations of Hg in black bread from fish caught in the Lakes, and the results of other research was reviewed. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury in fish caught in the Lakes over time with recorded mercury concentrations. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.

MO342 Mercury health risks due to the substitution of fish meat with shark meat. P. Ramirez Romero, U.A.M. Iztapalapa / Hidrobiología; L. Elizalde Ramirez, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; H. Barrera Villa Zevallos, UAM Iztapalapa / Hidrobiología

A previous three years study of mercury content in a variety of edible marine fish from Mexico City’s fish market was published. One of the main results of this study was that mercury health risks due to the substitution of fish meat with shark meat. Samples were bought in the fish market as fish for ceviche, quesadillas or soup, economical fillet, battered or breaded fish from sea bass, catfish, tilapia, red snapper and other popular species. Organochlorine universal organochlorinates in PCR were used to analyze the samples. 777 samples were applied to obtain information regarding fish consumption habits, portion sizes and other characteristics of the population of the Mexico City metropolitan area. Shark mercury content was taken from the previous study. Hg average daily dose, lifetime average daily dose and total dose were calculated for two consumption cases: (1) < 12 years of age (0.3 mg/kg bw/day) and (2) 12 years and older (0.5 mg/kg bw/day). Health risk was calculated using USEPA equations. Of the 52 “fish samples” analyzed 61.53% were identified as sharks of the following species: Leopold (Galeocerdo cuvier), Common sawshark (Pristiophorus cirratus), Goblin (Mitsukurina owstoni), nurse (Ginglymostoma cirratum), whale shark (Rhincodon typus), scalloped hammerhead (Sphyrna lewini), daggersnose (Isogomphon oxyrhyncha), silky (Carcharhinus falciformis). With regards to the health risk, when considering the lowest Hg concentration, children may eat only one 188 g portion/month, while fertile women and older people, two 190 g portions/month and men up to five 256 g portions/month. When considering the average Hg concentration, the number of portions/month is drastically reduced to less than one. With regards to the birth risk, if the amount of portions described before are respected, the calculated risk for babies was 0.83 but significantly reduced later in life if the lowest Hg concentration is considered. However, when calculating the risk with the average Hg concentration the risk quotient was always above 1 and up to 7.2 for babies. In conclusion there is a health risk when eating fish that cannot be identified, so people must buy whole fish to secure their identity and authorities should implement a monitoring program to penalize the sale of shark meat as fish meat.

MO343 Mercury in trophic webs of estuaries in South-Eastern Brazil. T.H. Trevizani, Universidade de Sao Paulo / Oceanografia Quimica; M.C. Vedolin, Instituto Oceanográfico da Universidade de Sao Paulo / Oceanografia Quimica; R.C. Figueira, Instituto Oceanográfico da Universidade de São Paulo / Instituto Oceánico; C. Domit, Universidade Federal do Paraná / Centro de Estudos do Mar

The estuarine regions of Brazil are susceptible to anthropic pressures due to urban,
MO344
Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada

M. Arduin, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology Sciences; University of Maribor; Upgrading.; F. Fogaça, Embrapa; T. Langerholc, Faculty of Agriculture and Life Sciences, University of Maribor;

Human exposure to mercury (Hg) and methylmercury (MeHg) increases in diets that include seafood. We aimed to understand the trophic dynamics of Hg and compare these estuaries. Samples were taken in the summer of 2015; analyses of δ15N were carried out by Elemental Analysis - Isotope Ratio Mass Spectrometry (EA-IRMS), and mercury analyses were carried out by Optical Emission Spectrometry, Inductively Coupled Plasma with Vapor Generator Accessory (OES-ICP-VA), in the muscular tissue of the organisms. The results of δ15N varied from 6.4 to 13.8 ‰ in Paranaúpolis and from 7.1 to 14.3 ‰ in Cananéia, with continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaúpolis (0.02 to 5.8 mg kg⁻¹) than in Cananéia (0.02 to 0.9 mg kg⁻¹), with maximum values in marine mammals, followed by invertebrates benthic and fish. Through linear regressions between Hg and δ15N, positive correlations were observed only in Paranaúpolis, but they were not significant, which indicates a trend of biomagnification of this element. Such a behavior is expe직히 서류를 통해 상속하는 인물의 경우가 많습니다. 그 데서 처음으로 공적으로 얻는 정보를 통해 확인하는 것이 중요하다. 다양한 오염물질의 배출과 환경오염이 지속적인 문제로 여겨지기 때문에, 이러한 현상을 이해하기 위해서는 침착하고 지속적으로 모니터링하는 것이 필요하다. 이를 위해, 풍부한 데이터를 수집하고 분석하는 것이 중요하다. 이러한 작업은 지속 가능한 경제와 환경 보호를 위한 중요한 단계 중 하나이다.
The upper basin of the Feúlida River, located in the Farallones National Park of Cali, Colombia, is subject to different anthropogenic stressors, such as mercury, the product of illegal mining. Using a direct quantification method (EPA 7473), it was studied the variation of total mercury (HgT) in the samples of the riparian fern *Thelypteris hispidula*, sediments and water in three streams: El Socorro, El Roble and El Pato, during the dry season, dry-rain transition and rainy season. Using non-parametric statistics (Kruskal Wallis), significant differences were found in the HgT between the periods, with a higher THg in the rainy season (p = 0.05), accumulating mainly in El Socorro. The HgT in the root of the plants presented differences in distinct sampling times (p = 0.005), increasing in the rainy season. The Spearman’s bivariate correlations showed that the dynamics of HgT accumulation in the root, is directly related to the concentration of HgT in the stem (rho = 0.918, p = 0.000) and leaves (rho = 0.900, p = 0.000). It was also evidenced that the accumulation of HgT in the root, is influenced by the concentration of HgT in the sediments (rho = 0.764, p = 0.000). These results demonstrate the environmental effects caused by mining activities in protected areas in Colombia.

**M3049**

Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Düelle River, northern France

M. Biettig, Istria Centre de Lyon - Villeurbanne; d. abarin, Istrea / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP); G. Billon, L. Lesven, Université de Lille1, Sciences et Technologies / Laboratoire de Spectrochimie Infrarouge et Raman; G. Grisot, Istrea Centre de Lyon - Villeurbanne / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP); P. Goupil, Université de Lille1, Sciences et Technologies / Laboratoire de Spectrochimie Infrarouge et Raman; L. Dheret, M. Coquy, Istrea Centre de Lyon - Villeurbanne / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP)

Due to several metallurgical plants along the river, the Düelle River is a highly polluted site in the northern France. Previous studies showed that sediments are polluted with Cd, Pb, Zn and Hg (Vdovic et al., 2006). Moreover, intense fluvial traffic generates regular resuspension of sediments leading to diurnal variations of metals concentrations in the dissolved and particulate phases. This was previously highlighted by in situ voltammetry approaches allowing to measure Pb, Zn and Cd with high frequency data acquisition (Superville et al., 2014). However, these measurements could not be performed for Hg with such probes, while previous field deployment of DGT (Diffusive gradient in Thin films) passive sampler suggested such variations. Indeed, time weighed average concentrations were 20 times higher (20 ng/L) than those measured in grab samples (1 ng/L). Thus, a field campaign was conducted during 15 days to assess diurnal variations of metals and Hg concentrations (dissolved, particulate and labile phases) related to fluvial traffic in the Düelle River, in the city of Aubry, downstream a metallurgical plant (Umicore). During the first week, DGT were exposed and grab samples were collected with a high sampling frequency (night and day). Then, a second set of DGT were exposed during the second week. The resuspension of particles and anoxic sediment caused by fluvial traffic was highlighted by the simultaneous increase of ammonium, Mn, Fe and U concentration (from 0 to 30 cm) and THg (3 to 34 ng/L). The analysis of metals and Hg in SPM showed increases of Pb, Zn, Hg and Cd concentrations in the particulate phase. The analysis of particulate Hg after two different filtrations at two cut-off points (0.45 and 0.70 µm) showed that particulate Hg re-suspended by fluvial traffic was mostly in the coarse fraction of SPM. Furthermore, the increase of SPM concentrations was related with an increase in dissolved Hg concentrations. These results suggest that when the anoxic sediment is remobilized by barge traffic, particles could be oxidized inducing a release of Hg. Moreover, since changes in redox conditions could also induce modifications in Hg speciation, further analysis will be carried out to measure Hg\(^{2+}\) and CH\(_2\)Hg\(^{+}\).

Finally, the interpretation of DGT measurements will show how well DGT integrate variations of inorganic contaminants concentrations during the exposure period.

**M3050**

The effect of activated carbon amendment on mercury methylation in contaminated sediment

E. Sorno, G. Cornelissen, L. Silvani, E. Eek, Norwegian Geotechnical Institute; H. Veiteberg Braaten, NIVA / Norwegian Institute for Water Research; N.W. Johnson, University of Minnesota Duluth / Civil Engineering

The conversion of elemental and inorganic mercury (Hg) to monomethyl mercury (MeHg) has been widely studied due to MeHg being more bioavailable, bioaccumulative and toxic to humans than the inorganic and elemental species. The net production of MeHg is controlled by both mercury methylation and demethylation, and a range of factors affects both processes. Sediments are known sites for MeHg production, as they are sinks for Hg, they have suitable red-ox conditions, a presence of methylating bacteria and more. Activated carbon has been much explored as a remediation tool for contaminated sediments. The carbon can immobilize contaminants, inhibiting the release to the water column and uptake in biota. Studies have shown that activated carbon also sorb Hg-species, but the mechanisms of how a carbon amendment affects the processes of Hg-methylation in contaminated sediments is not well understood. A lab trial was set up with sediment from two sites in Norway: The Gunnnekefjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations, being low in MeHg. Bulk concentrations were 25.5 and 9.5 mg/kg total mercury (THg) for GF and BH respectively. Two treatments were investigated: Activated anthracite char (AC) and activated biochar (BC). Treatments were set up for time series of 0, 1, 3 and 6 months in sealed glass jars, stored dark at room temperature. At each time series sediment and pore water was sampled. Activated charcoal (AC) and biochar (BC) were mixed in a ratio of 1:1 with an aragose diffusion gel and a sphenoid-thion resin gel. Pore water data show a net production of MeHg in the GF control, from an initial 8.7 to 393 ng/l within the first month, but it then drops off to 147 and 18.4 ng/l after 3 and 6 months respectively. Compared to the control, an initial reduction of 86% MeHg in pore water is seen for the AC treatment, that increases to >95% for the 1, 3 and 6 month time series. The BC treatment cause an initial 55% reduction of MeHg, but after 1, 3 and 6 months the reduction is >99% compared to the control. In the BH sample, there was no increase of the initial 2.1 ng/l MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >50%. Pore water MeHg-concentrations measured by DGT were similar to concentrations in extracted pore water, indicating that pore water MeHg is available for uptake.

**M3051**

Bayesian Human Health Risk Assessment of Almaden Mining Area

M.F. Ortega, D. Bolonio, C. Rodriguez, M. Garcia-Martinez, Universidad Politecnica de Madrid / Energy and Fuels; J. Esbrí Universidad de Castilla la Mancha / Geology and Mining Engineering; J. F. Llamas, Universidad Politecnica de Madrid / Energy and Fuels; P. Higuera, Universidad de Castilla la Mancha / Geology and Mining Engineering; L. Canoira, Universidad Politecnica de Madrid / Energy and Fuels

Almaden, with the largest and richest known mercury deposits is located in the southwest of Ciudad Real (Spain) with a population of 5,657 inhabitants (2016). This area can be considered one of the most affected by mercury in the world, both by its natural origin and by anthropogenic pollution since there are indications that the cinnabar mines of this region have been mined without interruption since before the fourth century BC until 2002. A probabilistic human health risk assessment has been carried out in order to establish whether mercury contamination of Almaden endangers human health currently or expected by 2030. A Bayesian modelling framework was adopted (Jara, 2014). The study was carried out from 15 March to 15 August 2017. As background data a general situation was assumed, estimating typical intake by ingestion and inhalation of dust from mining waste. From the results, it has been concluded that the probabilistic contamination of the Almaden mining area would not cause an increased risk of human health. In this way, the exposure variables are better defined by a posteriori-determined distributions that allow a better estimation of the risk. The results show that the human health risks obtained by ingestion of fish bought in local markets and vegetables grown in the area (lettuce, beans, tomato, onion, pepper, potato, cucumber and zucchini were analyzed) are not acceptable. The study reveals that future risk estimation of the Minamata Convention on Mercury may be needed. In this context, experts agreed that the Minamata Convention includes a ban on new mercury mines, and the phase-out of existing ones, this methodology could be used to establish if mercury contamination after mercury mines closure around the world endanger human health. E-mail contact: david.bolonio@upm.es, https://orcid.org/0000-0002-9166-1861

**M3052**

Concentrations of mercury in two offshore skates: sandy ray and shagreen ray

J.E. Nicolau, Cefas Lowestoft Laboratory / Environment and Ecosystems

Mercury concentrations in muscle and liver tissues from two offshore species of skate were examined. Concentrations of mercury in muscle of *Leucoraja circularis* (n = 15, head length = 10.5 cm total length, 157–490 m water depth) and *L. wallığıi* (n = 24; 28.5–100 cm total length, 130–426 m water depth) were 0.02–1.8 and 0.04–0.61 mg kg\(^{-1}\) respectively. Concentrations of Hg increased with total length. Only the largest specimen had a concentration of Hg in muscle >1.0 mg kg\(^{-1}\). Data were limited for specimens >90 cm long, and further studies on contaminants in larger-bodied skates could usefully be undertaken.

**M3053**

EMPIR project "MereOx - Metrology for oxidised mercury"

I. Fettig, Federal Environment Agency (Umweltbundesamt); M. Horvat, Jozef Stefan Institute; I. de Krom, VSL; D. Douglas, LGC; T. Rajamaki, VTT

Mercury (Hg) is one of the most toxic metals, and is regulated by the Industrial Emissions Directive (IED) 2010/75/EU, the Air Quality Directive 2004/107/EC, the Waste Incineration Directive 2000/76/EC and the Minamata Convention adopted in 2013: which is a global treaty to protect human health and the environment from the adverse effects of Hg. In addition to its elemental form Hg
also exists in oxidised forms (i.e. Hg(II)) that are reactive and can be transformed into organic Hg species such as methylmercury (MeHg), the most toxic Hg species and the one most prone to bioaccumulation in aquatic systems. Half of atmospheric Hg emissions are of natural origin whilst the rest are of anthropogenic sources, primarily from fossil fuel burning and other high temperature industrial processes (cement clinker production, waste incineration, ore roasting, steel production). Knowledge of Hg speciation both in air and in stack gas emissions is critical when validating models for predicting Hg emissions, transport, deposition and fate at the European level as well as on a global scale. Therefore, atmospheric Hg isotopic signatures that can be used to trace the origin and fate of atmospheric Hg also need metrological support and development. The overall goal of the EMPIR – Mercox project (Oct 17 – Sept 20) is to develop SI traceable measurements, for monitoring and control of mercury and its different species in gas emission sources and in the atmosphere. The project will achieve significant improvements in the measurement comparability and uncertainty of Hg measurement results. Currently, traceable calibration methods only exist for elemental mercury, but such measurements are also needed for oxidised Hg species in order to meet the requirements of EU regulation and the implementation of the Minamata Convention. The development of reliable and direct Hg(II) measurement techniques and reliable and traceable Hg(II) standards is solved to trace the reactivity problem that currently exists in measuring the total mercury (Hg\textsuperscript{0}) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg and for accurately comparing the Hg\textsuperscript{II} concentration in generated elemental and oxidised Hg reference standards are required, as well as tissue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill fits for the on-line measurement of Hg under field conditions and a comparison of Hg species inter-conversion.

MO354
PBTK/TD assessment of mercury (Hg(II)) accumulation in freshwater tilapia species
C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering; W. Chen, Kaohsiung Medical University / Department of Biomedical Science and Environmental Biology; Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering
Waterborne and dietborne exposures of freshwater fish to inorganic mercury (Hg(II)) affect their growth and reproduction. However, a mechanistic model to predict the impact of Hg(II) on freshwater fish is lacking. The purpose of this study is to develop a physiologically-based toxicokinetic/toxicodynamic (PBTK/TD) model to assess bioaccumulation of Hg(II) in freshwater tilapia. A PBTK model consisted of six interested compartments can be constructed including blood, gill, liver, muscle, intestine, and sediment. The chemical dose and physiochemical parameters can be estimated from published tilapia-related studies. The partition coefficients were estimated for each tissue or organ based on the experimental data by dividing Hg burden in tissues of that in blood at specific days after Hg(II) exposure. A series of experimental data were analyzed to reconstruct the dose-response profiles describing the relationships between tissue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used to describe the dose-response relationships. Here we showed that tissue/organ burdens would reach equilibrium before 180 days of exposure in all six rivers. Among all exposed tissues/organs, kidney had the highest internal exposure doses of Hg(II) ranging from 0.0208 – 0.1348 μg g\textsuperscript{-1} ww. In contrast, muscle had the lowest internal exposure doses of 0.0001 – 0.0003 μg g\textsuperscript{-1} ww(Hg(II)), indicating that Hg(II) in muscle will be well below levels required at risk for human consumption based on regulation from Taiwan FDA. The highest accumulative internal dose of Hg(II) was in gill of 0.0115 (95% CI: 0.0007 – 0.1907). The effective Hg(II) burden in tissue/organ at 50\% mortality for liver, gill, and muscle were 10.410 ± 1.047, 6.307 ± 0.756, and 2.839 ± 0.575 μg g\textsuperscript{-1} ww, respectively. A fair quantitative agreement between model predictions and experimental data was also reached. Sensitivity analysis indicated that the amount of Hg accumulated in tilapia whole body was most influenced by sediment uptake rate, indicating that sedimentborne Hg exposure was the most influential factor on accumulation of tilapia that is bottom-feeding fish. We suggest that more dose-response data of sublethal and chronic effects are required to improve future risk assessment in a mechanistic and practical way. In a broader way, our model can be applied to predict continuously chronic Hg accumulation in fish that are deemed safe for human consumption.

MO355
Mercury in fish, fish intake and fish consumption recommendation
H. Coelho Vieira, University of Aveiro; A. Gergs, Bayer AG / Crop Science Division / Department of Environmental, Social and Spatial Change; K. Lademann, Research Institute gaia; E. Zimmer, IBACON GmbH; T. Preuss, Bayer AG / Environmental Safety; V. Ducrot, Bayer AG / Environmental Safety
Ecotoxicology
In current environmental risk assessment (ERA), plant protection products (PPPs) are tested on a diversity of standard test species for harmful effects. Recent developments in mechanistic effect modelling provide the possibility to extrapolate risk assessment from standard studies to a wide range of species for various toxicological scenarios or exposure situations, which will improve the quality of ERA as well as saving time and resources. Toxicokinetic-toxicodynamic (TKTD) models for lethal effects have already proven the ability to identify patterns in effects across compounds and species. The Dynamic Energy Budget (DEB) theory may have the potential to provide a general modelling framework for sublethal effects. Models based on DEB theory have been used in ecotoxicology for decades, and these models are currently under discussion as standard approach for risk refinement at the level of tier-2. Models based on DEB theory allow for mechanistic interpretation of effects on feeding, energy expenditure, growth and reproduction. The same modelling framework can be used for all organisms, which is crucial for across - species extrapolation of effects. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feed or assimilate energy. Thus, MeHg and other contaminants, such as organochlorines and heavy metals, are ingested (by meal) and levels of MeHg in fish. The Hg concentration found in the hair indicates that individuals with higher fish consumption per week generally have higher concentrations of Hg and in order to meet the USA dietary guidelines, which recommend a consumption of 227 g; only fish with MeHg concentrations below 0.14 μg g\textsuperscript{-1} (“exception list”) is allowed for fish consumption.

Mechanistic effect modelling for risk assessment: applications, use in a regulatory context and future directions (P)
R. Ashauer, University of York / Environment; T. Jager, DEBtox Research / Dept of Theoretical Biology
The additional information and insight gained through the application of toxicokinetic-toxicodynamic modelling can strengthen the environmental risk assessment of chemicals in consumer products or plant protection products. For the endpoint survival the most suitable and powerful tool is currently the General Unified Threshold model of Survival (GUTS(V)), which consists of two complimentary models: GUTS-SD (stochastic death) and GUTS-IT (individual tolerance). In order to ease the use of GUTS and increase trust and acceptability we recently carried out a ring-test of eleven different implementations of GUTS. The frequency of erroneous results due to programming errors and less appropriate settings for numerical solvers or parameter search and convergence algorithms indicated that user training and experience is key. However after correction of user errors all software implementations resulted in comparable and similar results. Estimated parameter values generally agreed well and the implementations returned similar results in scenario and acute toxicity mode. The next step is to develop a quality assurance system in which new users and new GUTS implementations should be trained using this ring-test and refer to these results as benchmark. Any new user should run the ring test exercises and improve their modelling techniques until they achieve comparable results. Standardisation of typical use cases could also help to reduce sources of error as well as corresponding, user-friendly, robust GUTS software. This software could reduce sources of error by restricting user-choice to only those options suitable and relevant for the regulatory risk assessment under consideration.

MO357
Feeding impairment in fish explained by a TK-TD model
S. Augustine, Akvaplan-niva; A. Gergs, Bayer AG / Crop Science Division / Department of Environmental, Social and Spatial Change; K. Lademann, Research Institute gaia; E. Zimmer, IBACON GmbH; T. Preuss, Bayer AG / Environmental Safety; V. Ducrot, Bayer AG / Environmental Safety
Ecotoxicology
In current environmental risk assessment (ERA), plant protection products (PPPs) are tested on a diversity of standard test species for harmful effects. Recent developments in mechanistic effect modelling provide the possibility to extrapolate risk assessment from standard studies to a wide range of species for various toxicological scenarios or exposure situations, which will improve the quality of ERA as well as saving time and resources. Toxicokinetic-toxicodynamic (TKTD) models for lethal effects have already proven the ability to identify patterns in effects across compounds and species. The Dynamic Energy Budget (DEB) theory may have the potential to provide a general modelling framework for sublethal effects. Models based on DEB theory have been used in ecotoxicology for decades, and these models are currently under discussion as standard approach for risk refinement at the level of tier-2. Models based on DEB theory allow for mechanistic interpretation of effects on feeding, energy expenditure, growth and reproduction. The same modelling framework can be used for all organisms, which is crucial for across - species extrapolation of effects. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feed or assimilate energy. Thus,
predicting effects on feeding and assimilation is a crucial characteristic for a TKTD model to predict sublethal effects in the context of ERA. We present here the results of the i-ERA project (integrated ERA) on the responses to low food conditions / feeding impairment in four fish species (rainbow trout, fathead minnow, zebrafish and medaka). We tested the DEB model for predicting organism level responses of juveniles (rainbow trout) and adults (all others) under low food conditions. We find that for the two former conditions, fish do not change their stabilisation compared to the standard DEB model. This indicates that the model can be used in ERA for the four fish species analyzed here to predict effects of compounds that act on feeding inhibition without any adaptation. The differences in the organism-level response to low food conditions / feeding impairment between the four species can be explained by differences in their model parameters. The standard DEB model can be extended to different pulse scenarios with low food conditions and different pulse adaptations required in such cases, and discuss how the model can be used in risk assessments for weight-of-evidence in tier-1 and tier-2 as suggested by EFSA.

MO359 TK-TD modelling as additional line of evidence in the risk assessment for aquatic macrophytes: chlorotoluron as a case study J. Klein, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecotoxicology; U. Hommen, Fraunhofer IME; G. Weyman, ADAMA To assess effects of the use of plant protection products based on chlorotoluron as active substance, various designs of laboratory tests with Lemna sp. and other species and also mesocosm studies including different macrophyte species are available. Since it is not possible to derive reproducible results in long-term exposure scenarios, TK-TD modelling was used as an additional approach to address the potential effects of short-term exposure as predicted for some FOCUS surface water scenarios. The Lemna TK-TD model developed by Schmitt et al. (2015) was used to simulate laboratory tests assuming exponential growth as observed in the experimental controls. Growth under field conditions was modelled as dependent on the species and their specific light conditions. The substance-specific TK-TD parameters were calibrated using the results of a growth inhibition test with 7 days of exposure followed by 7 days of recovery in fresh medium without test item. The so calibrated model was verified by comparing its predictions with results of three other tests with different exposure patterns, some of which were designed with this purpose in mind. Modelling scenarios were close to or above 0.9 for all four tests and, thus, the model was considered suitable for simulating effects of different exposure patterns on the growth of Lemna. We simulated laboratory refined exposure tests with PEC profiles of the 7 days worst-case time window of the FOCUS step 3 scenarios as well as field populations using the full FOCUS profiles as inputs. For the exposure profiles characterised by short-term pulses, margins of safety were above 10 to reach a 50 % inhibition of the growth rate over 7 days, the endpoint used in Tier 1. For the simulated field tests, maximum deviation of biomass under control and exposure conditions was used as assessment endpoint. If up to 25 % deviation of biomass of an exposed population from a control population is considered a negligible effect, the Margins of Safety was above 20 all analysed scenarios. The experimental results were characterised by short-term impact on growth. The exposure profiles considered here will, with a high probability, not lead to unacceptable effects on macrophytes. This project demonstrates the usefulness of modelling as additional tool in risk assessment of plant protection products, particularly for extrapolation between scenarios which cannot all be tested experimentally.

MO358 RIFCON EasyGUTS: Ready-to-use and freely available software for TK/TD modelling of survival D. Nickisch, O. Jakobi, A. Mediancve, Rifcon GmbH GUTS (General Unified Threshold model of Survival) is one of the most commonly used models for toxicokinetic and toxicodynamic evaluations of aquatic experiments in the context of the European registration of plant protection products at lower tiers in the ecotoxicological risk assessment. One user friendly implementation of this model is the Windows based program EasyGUTS. This implementation and its functionalities were recently tested and verified using published data. Results obtained with EasyGUTS are in good agreement with results obtained from various other publications and model implementations. However, one limitation of the program during this verification process was that it was only possible to select the log-normal distribution for the individual tolerance model rather than giving the possibility to also use other functions like a log-logistic distribution. This was the case since the GUTS R package to which EasyGUTS is linked, is restricted to only this possibility. Since a TK/TD draft guideline is expected earliest next year and no preference for a distribution is given in recent publications, in line with the EFSA ‘Scientific Opinion on Good Modeling Practice’. Moreover, EasyGUTS as a functional tool was tested in internal and external modelling workshops. Experience is that the usability of the software and the robustness of the calibration algorithm was fitting well, so that even all users could reproduce results and decisions. Since EasyGUTS is finally verified and harmonised with the R GUTS package, it is ready to use under free license agreement and can be downloaded from the RIFCON homepage beginning of 2018. This poster presents the EasyGUTS software and gives insight on the sensitivity of the model to initial parameter values and the influence of different distributions used for the individual tolerance model.

MO361 A new test design to inform TKTD models on species sensitivity E. Bums, Bayer AG / Division Bayer CropScience / Ecotoxicology; K. Kuhl, Bayer AG / CropScience Division; J. Hager, Bayer AG; T. Preuss, Bayer AG / Environmental Safety Recently, several TK/TD population modelling approaches have been developed and are applied in different risk assessment areas. The European Food Safety Authority (EFSA) guidance on tiered risk assessment for plant protection products for aquatic organisms in edge-of-field surface waters of the R GUTS modelling as an approach for the aquatic risk assessment for the evaluation of time variable exposure. For aquatic invertebrates two key questions exists for the ecological threshold option. 1) What is the species sensitivity distribution 2) What are the effects from short-term / peak exposure patterns on long-term survival and reproduction. Currently TK/TD models are parameterised on the standard Tier 1 or Tier 2 scenarios. Particularly for aquatic invertebrates, test protocols are designed to be exposed over long time periods (week to months), which makes these experiments costly, time consuming and which limits the number of non-standard species to be investigated, as these species - in the absence of appropriate husbandry and test methods and due to complex biology - are particularly challenging to test reproducibly in chronic set-up’s. Here we will present an approach using the GUTS model (TK/TD model for survival) informed by specifically designed peak-exposure experiments to answer both questions. We will employ short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different treatment levels of an insecticide, in combination with several observation time points for 5 aquatic insect species and 3 crustaceans. The outcome of these experiments will inform the TKTD model and will allow for a suitable calibration, after which it will then be possible to construct pattern-specific species sensitivity distributions to be used in acute effect assessments for time variable exposure patterns like FOCUS scenarios. Moreover, the approach may also provide further insights whether peak exposure experiments in an acute study design can be used to investigate sensitivity differences also on a longer-term time scale, by concurrently preventing the pitfalls and potential artefacts arising from not yet developed, adequate long-term husbandry- and test protocols for non-standard species.

MO362 Impact of temperature on species sensitivity distribution in aquatic invertebrates K. Lademann, S. Classen, Research Institute gaiac; T. Strauss, M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; A. Gergs, Bayer AG / Crop Science Division / Department of Environmental, Social and Spatial Change
Aquatic effect assessment uses results from laboratory experiments at constant environmental conditions. However, for these tests organisms are kept under optimal temperatures which might differ across species. If done for multiple species, results from these toxicity test are used to statistically derive community level endpoints, such as the HC5, from species sensitivity distributions (SSDs). Therefore, data from acute toxicity tests are ranked using cumulative distribution. Apparent toxicity endpoints, such as the LC50s, have been reported to depend on ambient temperature at the time of the test and differences in thermal acclimatization. If comparing species sensitivity the results might be biased by the experimental conditions. It has been demonstrated that changes in physiological rates with different temperature regimes can be described by the Arrhenius function. Part of this study is to examine if the Arrhenius function is also able to predict TKTD model rates, such as GUTS, for different temperatures. We use GUTS to extrapolate toxic effects across temperatures and investigate the impact on temperature on a species sensitivity distribution (SSD) with aquatic invertebrates regarding Chlorpyrifos.

MÖ365 The use of population models in copper risk assessment: a case study with Aciopener transmontanus
K. Vlaeminck. Arche consulting / GHenToxLab; K. Vlaeia, Ghent University / GHenToxLab; P. Van Sprang, ARCHE. K. De Schampheleere, Ghent University (UGent) / Applied Ecology and Environmental Biology
Current metal risk assessment consists of assessing single-species data on metal toxicity and constructing species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDs have been criticized over the last decades for being ecologically unrealistic, and for typically only accounting for individual-level endpoints. Population models as an alternative are becoming more popular in ecotoxicology as they translate a pollutant’s effects on individuals (e.g. survival) to the population level (e.g. growth rate). Additionally, ecological models are less expensive and time-consuming to develop and perform research with compared to population experiments. In this study, we aimed at adapting an existing white sturgeon (Aciopener transmontanus) population model to predict population level effects of copper toxicity. The white sturgeon is a fish species particularly sensitive to copper during early developmental life stages. An individual-based model (IBM) was implemented using the software platform NetLogo. Copper effects were integrated by adjusting the mortality rate for the sensitive life stage (age-0 individuals) For different scenarios (i.e. environmental configurations, exposure profiles, etc.) population-level effects were assessed as a function of the copper concentration. As expected, population equilibrium density decreased with increasing copper concentrations. Effect concentrations (EC, values) for population equilibrium density were situated in the same range as (traditional) lethal concentrations (LC, values) at the individual level. Nonetheless, the magnitude of the population’s response to copper depends on several environmental factors such as habitat fragmentation and distribution of the pollution in the river system (random, heterogeneous, or homogeneous). Population EC, values were derived with the IBM by extrapolating observed (conventional) LC, values from literature. Here, we applied the adapted population model for A. transmontanus contains some inherent assumptions which need further fine-tuning. By investigating the mortality profile (i.e. mortality over time) in depth, the mortality sub-model could be improved further, increasing predictability of the model. Additionally, investigating population density-dependent effects on the survival of age-0 individuals could increase accuracy as well. This study shows that population models could be used as more ecologically-relevant tools in metal risk assessment.

MO364 Defining ecological lake scenarios for population modelling as part of the Ecological Risk Assessment of chemicals
T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; A. Hirs, Risk - AG / Crop Science Division; A. Meus, Department of Environmental, Social and Spatial Change; K. Ladermann, Research Institute gaiac; M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment
The ecological risk assessment of chemicals (ERA) aims to minimize adverse ecological effects on populations and ecosystems. This assessment strongly depends on the modelled species and the underlying ecological scenarios and the species sensitivity to anthropogenic stressors. This also applies to the populations of planktonic species and fish in standing waters (lentic systems), many of them being focal species in ERA. For use in population modelling, we suggest a classification of ecological scenarios of lentic systems based on the EU Water Framework Directive (WFD). As a result of the European intercalibration process, a list of general lake types has been defined which includes many of the aspects that are important for lake modelling. Besides abiotic characteristics, the German lake classification system for the national implementation of the WFD additionally makes use of biocenotical and trophic descriptors, and provides short characterizations of typical characteristics for relevant lake types. For the German lake types, data on e.g. phytoplankton biomass and nutrient concentrations are available from natural reference lakes which can serve for model validation. As case studies, we have chosen three lake types from this list of general lake types, which differ in relevant lake properties such as morphometry, trophic state, water depth, stratification regime during summer, and food web structure of the pelagic food web. We additionally considered common anthropogenic lakes and ponds (e.g. eutrophic ecosystems) and shallow lentic ecosystems through the use of the risk assessment model which are relevant for the ERA of chemicals in Europe. For the simulations of these ecological scenarios, the biogeochemical lake model StoLaM was used, in which several phytoplankton and zooplankton groups as well as fish are implemented. Additionally, the one-dimensional vertical structured hydrodynamic model HyLaM as part of the StoLaM allows high resolution of the lake internal physical environment which is required for simulating the nutrient and plankton dynamics in detail. Based on scenario analyses, simulations of typical plankton dynamics in lake systems will be presented and discussed.
sensitivity distribution (SSD), and results from model ecosystems and field studies whose task is to extrapolate single-species data to ecosystem-level responses. Although AF and SSD methods are described by strict guidelines making them commonly applied, they do not consider the effects of ecological interactions between species on the assessed risk level, which is potentially not-negligible since population dynamics in polluted environment are not only driven by direct toxicity of chemicals on single species. One cost-effective alternative for assessing the ecological risk of chemicals considering also indirect ecological effects is the use of mechanistic ecosystem models, simulating the multiple interactions between biotic and abiotic ecosystem compartments. However, there is lack of official guidance for models choice, development and use, resulting in scarce implementation of ecological models for regulatory purposes. Accordingly, two main goals of this work were to test a methodology for deriving PNEC by use of the US- EPA AQUATOX ecosystem model, and to evaluate the risk posed by PFAAs (represented by two long-chained and two short-chained compounds) in the ecosystem of the Po, the greatest river in the Northern Italy. Through AQUATOX, water concentrations of PFAAs resulting in a non-negligible biomass loss for each modelled population of the ecosystem were assessed, thus connecting biomass density (a model output) to a “safe” concentration (PNEC). The resulting PNECs were compared to PNECs derived with conventionally used AF and SSD methods to assess the performance of the proposed novel methodology.

MO368 Incorporating spatially explicit metapopulation models as the endpoint of an Adverse Outcome Pathway-based Bayesian Network-Relative Risk Model J.D. Stark, Washington State University / Dept of Entomology; C. Mitchell, Washington State University / School of the Environment; V. Chu, Western Washington University / Environmental Science; M.E. Harris, Western Washington University; L. Wallis, Western Washington University / Institute of Environmental Toxicology; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; K. von Stackelberg, NEK Associates LTD / Department of Environmental Health

Population viability analysis is useful for assessing the environmental risk of toxicants because it produces endpoints relevant to managers and can be manipulated to compare the potential outcomes of conservation actions. In general, many Environmental Risk Assessments (ERAs) lack utility and realism because they fail to incorporate the combined effects of lethal and multiple sub-lethal impacts, environmental stressors, and chemical mixtures into a relevant endpoint for managers. To improve the utility of regional scale risk assessment, we are developing a Bayesian Network-Relative Risk Model that incorporates the combined effects of toxicants and environmental stressors into an Adverse Outcome Pathway (AOP) framework linking environmental conditions to spatially explicit metapopulation models. As a primary case study for this new model, we are examining the impacts of organophosphate (OP) insecticides on ESA-listed chinook (Oncorhyncus tshawytscha) and coho (Oncorhyncus kisutch) salmon populations using site specific data from the Lower Skagit, Nooksack, Cedar, and Yakima River watersheds in Washington State. The AOP within the BN-RBM links concentrations of OPs to % Acetylcholinesterase (AChE) inhibition which is then linked to sublethal impacts that are incorporated into matrix metapopulation models through age-specific reductions in survival and reproduction. The outcome of this effort will be an adaptable management tool that uses existing, disparate data to link realistic toxicant concentrations to probabilistic population outcomes. The primary results from this model development will be used to enhance a previously developed (Bauer et al 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Enoch et al., 2008) and Russom (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russom et al., 1997) methods, and our decision tree showed the best statistics. This method is currently being implemented into a software, and it will be made freely available and we consider it as a useful support in risk assessment. This model will be expanded and enhanced with the addition of new rules and minor corrections as needed.

MO369 Modeling and monitoring the effects on the central nervous system of a chronic exposure to low dose of pollutants: an innovative strategy with first results T. Claudepierre, URAFPA INRA / URAFPA INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAFPA INRA; M. DELANNIOY, URAFPA INRA / URAFPA INRA; A. El Hajj, T. Oster, C. Malaplate, Université de Lorraine UL / URAFPA INRA; N. Tran, Université de Lorraine UL / Ecole de chirurgie, Faculté de Medecine de Nancy; F. Yen-Potin, C. Feidi, Université de Lorraine UL / URAFPA INRA

Chronic low dose exposure and possible cumulative effects of various pollutants can affect consumer health and may contribute to the development of neurodegenerative pathologies. Due to the highly complex and long exposure, a chronic effects are not well understood. The effects of pollutants and their potential to cause chronic diseases are often suspected, but rarely proven. An additional drawback is the high diversity of in vitro models (cancer cell lines, stem cells, primary embryonic cells), bringing additional complexity in the deciphering of the observed effects of pollutants. To properly assess the risks and to reevaluate the maximal acceptable dose of specific pollutants in the food chain, there is a need for efficient modeling of pollutant effects on the central nervous system (CNS). To address this need, we are developing a new approach to evaluate the consequences on neuronal health of long time exposure to pollutants. We are actually re-evaluating the neurotoxic effects of chlordecone (CLD) as proof-of-concept of our strategy. Several concentrations of CLD were used to treat a variety of mouse primary neurons isolated from different postnatal CNS areas. We then assessed neuronal functions using specific markers for neuronal death, neurite development and synapse formation. In parallel, we produced cerebrospinal fluid (CSF) from pigs exposed to CLD via contaminated food. This CSF containing CLD and its by-products that are able to cross the blood brain barrier could then be used on the same cultures to compare its effect with that obtained with the following direct treatment with the molecule. We were able to identify a direct neurotoxic effect (10 µM) on specific purified neuronal cultures together with more subtle damages at lower concentrations including neurite arborization defects (0.1 to 1µM depending on the respective neuronal cultures). Additional effects on pure glia cell cultures at higher concentrations (100 µM) suggest a reactive gliosis in the whole animal. These observations were confirmed by CSF treatment using CLD-contaminated CSF but not with CSF from control pigs. In addition, the dose with no observable effects is at least 10 times lower using primary postnatal neuronal cultures compared to embryonic cultures. Our experimental model is therefore much more sensitive and may reflect more precisely the consequences of chronic CLD exposure. Our strategy could help to re-evaluate the CNS effects of this remnant pollutant present in West Indies soils.

MO370 A new classification method for mechanisms of toxic action F. Bauer, KREATIS; P.C. Thomas, CEHTA SAS / Ecotoxicology and Risk Assessment

A knowledge of the mechanism of action (MechoA) of substances is a crucial first step in risk assessment approaches, especially when using in silico models to predict (eco)toxicity. Mechanisms of Action are similar to Molecular initiating Events which govern molecular interactions between xenobiotics and biological material. Using the accumulated knowledge of MechoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechoAs. Consequently, a new method to predict MechoAs with high accuracy and with simple rules was developed (Bauer et al 2018) using a mechanistic classification with 6 general MechoAs including 23 detailed MechoAs. The MechoAs are given mainly for mammals and fish but information on other species was also included. We used a training set of 301 molecules, and validation set of 491 molecules. Our method was built as a linear decision tree composed of 62 decision rules. This method achieved 92.0% correct classifications for the training set and 92.3% for the validation set. 6% of the predicted classifications were slightly different from the literature MechoAs for the training set (3.4% for the validation set) and 1% of the training set was misclassified (4.3% in the validation set). Finally, only 1% was out of the applicability domain for the training set while no molecules from the validation set were unclassified. This model is both simpler and performs better than the previous one described and developed (Bauer et al 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Enoch et al., 2008) and Russom (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russom et al., 1997) methods, and our decision tree showed the best statistics. This method is currently being implemented into a software, and it will be made freely available and we consider it as a useful support in risk assessment. This model will be expanded and enhanced with the addition of new rules and minor corrections as needed.

Biocides and Veterinary Medicines: latest developments in regulatory risk assessment, research and monitoring (P)

MO371 Biocide leaching from building facades: Pseudo-persistence in soil due to reoccurring emissions U. Bollmann, Aarhus University / Environmental Science; D. Fernández-Calviño, K.K. Brandt, University of Copenhagen / Department of Plant and Environmental Sciences; M.S. Storgaard, Aarhus University, Department of Environmental Science / Department of Environmental Science; H. Sanderson, K. Bester, Aarhus University / Environmental Science

Facade paints and render are commonly protected against biological deterioration using biocides. Mixtures of in-can as well as film preserving bactericides, algacides and fungicides are added to the materials. Nevertheless, active ingredients leach from the treated facades, if contacted with wind-driven rain. Especially in suburban residential areas a large fraction drains directly to soil, e.g., flowerbeds, gravel strips or the lawns surrounding the houses. Consequently, the soil in areas with biocide-treated buildings is exposed to rain runoff water highly polluted with biocides. In the present study, the degradation rates of eleven biocides in soil were determined in laboratory microcosms. Degradation half-lives ranged from rapidly degrading (T1/2 < 10 d) to compounds with higher persistence (T1/2 > 120 d). For two selected biocides (terbutryn and octylisothiazolione) a set of transformation products were quantified in the microcosms as well. This showed that the mass balance for terbutryn could be closed with nine analysed transformation products for the entire incubation period (120 d), revealing that relative persistent metabolites are formed. In contrary, the mass balance including transformation products for octylisothiazolone was not closed, as transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Aliivibrio fisheri than the
respective parent compounds. Nevertheless, for most biocides the degradation half-life is longer than time intervals between rain events in Northern Europe. Hence, though many of the used biocides are degrading relatively rapidly in soil most of the compounds residues may accumulate in soil surrounding biocide treated buildings, due to repeated input with every driving-rain event. Consequently, most biocides can be considered as "pseudo-persistent"-contaminants in this context. This was verified within the present study by (sub)arable soil screening, where concentrations of up to 0.1 μg g⁻¹ were detected for parent compounds as well as terbutryn degradation products in soils below biocide treated facades.

MO372 Biocides in façade coatings: Influence of pigments on the phototransformation of biocides - M.M. Urbanczyk, Aarhus University (AU) / Department of Environmental Science (ENVS); U. Bollmann, Aarhus University / Environmental Science; N. Botho, Dr. Robert-Murjahn-Institut; U. Schoknecht, BAM Federal Institute for Materials Research and Testing; K. Bester, Aarhus University / Environmental Science Biocides are common additives in façade coatings to protect the materials against biological deterioration. In case of glaze pigments preservatives are used for this purpose. Nevertheless, these biocides leach to the environment when the façade is getting in contact with driving-rain. Long-term exposure tests in natural weather showed large gaps in the mass balances, indicating towards other loss mechanisms. The present study focused on phototransformation as a major pathway for active ingredient loss. In laboratory experiments in UV-weather chambers the formation and fate of photodegradation products and transformation of the biocide treatment was studied using red, black, white paints and a pigment-free formulation in comparison. It could be shown, that pigments have a huge influence on photodegradation of biocides. First, pigments shield the biocides from phototransformation. Biocides are much faster transformed in the pigment-free formulation, while similar transformation rates can be determined for the red, black and white paint. Second, pigments interact with the biocide’s phototransformation, leading to different transformation patterns with different pigments. The loss rate of the parent for the red and the black paint were nearly indistinguishable, while small differences concerning formation of transformation products were determined for the white paint.

MO373 New Developments in Environmental Emission Scenarios of Biocides - Rodenticides - E.-P. Petersen, German Environment Agency (UBA) / Section Biocides; K. Wege, A. Friesen, German Environment Agency UBA; M. Amre, S. Harth, DR. KNOELL CONSULT GmbH

Rodenticides as biocidal products are regulated according to Regulation (EU) No 528/2012 (BPR). In both frames - evaluation of active substances as well as authorisation of biocidal products – a risk assessment needs to be carried out for biocidal products entering the environment. In the latter case, an Environmental Scenario Document (ESD) providing methods for release estimation of active substances from biocidal products to the environment. In case of rodenticides (product type 14 of BPR), the current available ESD for Rodenticides (2003) has been reviewed to take account of realistic biocidal product applications as well as worst-case environmental exposure assessment. The German Environment Agency (UBA) has commissioned Dr. Knoell Consult GmbH for drafting a revised ESD for PT 14 (rodenticides) on the basis of European Competent Authorities experiences gained during active substance approval and product authorisation, experiences from a workshop on risk mitigation measures for anticoagulant rodenticides, knowledge and common practice of trained pest operators, rodenticides associations, experiences from awarding public and private authorities and furthermore. New scenarios or sub-scenarios have been developed in case of application of rodenticides in sewer systems (with reference to the different types of pipe systems) and of application in and around buildings (distinction between direct applications on paved and unpaved soil; integration of an indoor baiting scenario). A new scenario for bank slopes of water courses has been established, whereas the waste disposal site and the urban area scenario from the original ESD for PT14 have undergone minor adaptations. When exposure of the terrestrial compartment is considered the transport of biocidal active substances to aquifers and groundwater has to be allowed for. In case of rodenticide application an appropriate approach for estimation of local concentrations in groundwater is newly included in the revised ESD for PT14. The risk assessment for primary and secondary poisoning of non-target organisms was revised in order to provide a more generic approach, i.e. identifying focal non-target organisms. Furthermore, guidance already provided for plant protection products has been considered. The presentation aims at providing an overview of current developments in environmental emission and exposure estimation of rodenticides as biocidal products.

MO374 New Developments in Environmental Emission Scenarios of Biocides - Preservatives for products during storage - K. Michalis, German Environment Agency (UBA); M. Schwander, German Environment Agency Umweltbundesamt; M. Galler, M. Schweitzer, SCC GmbH

Preservatives for products during storage are also known as in-can preservatives and are regulated according to Regulation (EU) No 528/2012 (BPR). These preservatives are biocidal products which are used in many different end-products (e.g. detergents, paints, glues etc.) to prolong their service life. The environmental emission of these end-products is evaluated in an Emission Scenario Document (ESD), whereas the existing ESD for in-can preservatives does not contain calculations for the variety of all end-products. Consequently, the German Environment Agency (UBA) initiated a research and development project for the further development of the evaluation method of in-can preservatives. The draft for the revised ESD has been prepared by SCC GmbH on behalf of the German UBA. Due to the variety of different applications of in-can preservatives, a differentiation in 6 sub-categories was defined. Additionally, for a complete environmental emission estimation different life cycle steps of the biocidal end-product have to be assessed. Consequently, the incorporation of the in-can preservative into the end-product (formulation) as well as the uses of the end-product (application and service life) within a subcategory have to be considered. To reduce the workload and to homogenize the emission estimation it was decided to define emission scenarios which describe a realistic worst-case situation for the environment refer to application amount, emission days and release fractions. On the basis of expert knowledge, draft competent authority reports of in-can preservatives and a survey between stakeholders, industry and other EU member states worst-case scenarios were identified and discussed at EU level. Finally, the revised ESD suggest one or a few worst-case emission scenarios for the pigments. Using a prioritisation concept for biocides a worst-case scenarios, calculation sheets for the estimation of the emission from other uses are provided as Appendices, so that the emission from other end-products (non-worst-case scenarios) can be calculated as well, by using this ESD.

MO375 Monitoring of Biocides in German Sewage Treatment Plant Effluents - First Results - C. Meier, German Environment Agency (UBA) / Biocides; K. Pohl, German Environment Agency (UBA) / Section Biocides; M. Ahling, I. Noeh, German Environment Agency UBA / Biocides; A. Thoma, F. Sacher, DVGW Water Technology Center; M. Kaiser, S. Fuchs, Karlsruhe Institute of Technology KIT / IWG

Due to a widespread use, biocidal active substances and their transformation products are expected to be found in the environment. Projections show that there will be an increase of biocide entries in the environment, mainly in urban areas due to an increased use of e.g. disinfectants and especially masonry preservatives. Biocidal substances enter the environment through numerous entry pathways. One main entry path is through sewage treatment plants (STP). Therefore, the German Environment Agency (UBA) initiated a project where the effluent of 29 public STPs from all over Germany will be investigated over a period of one year, starting in November 2017. Additionally, selected samples from influents as well as from sewage sludge emissions will be in the focus. Using a prioritisation concept for biocides a list, ranking substances that enter the environment through the STP-pathway, was generated. The list was judged by experts and finally, for this project 23 biocidal active substances or transformation products were chosen for analysis. First results show that several substances can be detected at measurable concentrations in the effluents. This ongoing project will provide better knowledge about the fate and behaviour of biocides entering the environment through sewage STPs. It will give us a time dependent picture of the environmental pollution by biocides in Germany through urban STPs and will also show possible fields of action for regulatory purposes.

MO376 The 'risk envelope approach' applied to environmental risk assessments for disinfectants - a strategy to reduce workload for biocidal product families - A. Vanden Bosch, ARCHE; L. Jansen, Arche consulting; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; E. Van Ael, A. Ghekere, Arche consulting; F. Verdonck, ARCHE; T. De Wilde, Arche consulting

Under the Biocidal Products Regulation, applicants can apply for authorisation of biocidal product families (BPFPs), which consist of products with similar uses, the same active substances, similar compositions within specified variations and similar levels of risk and efficacy. Especially when consortia are formed and products from multiple companies are grouped into a single dossier, building a dossier to demonstrate safe use for all products may become burdensome. Hence, there is a strong need to reduce the amount of risk assessments required to support the BPFPs, in the interest of the applicants as well as the competent authorities. BPFPs are typically subdivided into subfamilies called 'meta SPCs'. The subgrouping in meta SPCs considers a.o. the composition, formulation type, product type (PT), risk mitigation measures (RMMs), classification and labelling (C&L) and shelf-life of the biocidal products. These SPCs are then used in environmental risk assessments, however, most often do not coincide with the factors that determine the meta SPC structure. Instead, other grouping strategies are more fit for purpose. The risk envelope approach is a strategy routinely applied in...
plant protection product dossiers. It entails that - for each area of risk assessment - the key parameters driving that risk assessment are identified. Subsequently, the uses are grouped and ranked according to these key parameters. As such, one or more worst case or ‘critical’ uses can be identified. If it can be demonstrated that there is no undue risk to men or environment for the critical use, all other uses are considered to be covered as well. A case study will be presented whereby the concept of the risk envelope is applied to the environmental and risk assessment for a BPF of disinfestants (PT 1-5). Risk assessments can be grouped (a) for different products/uses within a matrix SPC, and (b) for different products/uses across meta SPCs. Overall, applying the risk envelope approach may lead to a great reduction in workload, whilst allowing for easy addition of products/uses to the BPF at a later stage. The benefits and potential difficulties of this approach will be discussed in detail.

MO379 Hazard evaluation of biocides and their metabolites for the aquatic compartment D. Hernandez-Moreno, INIA / Environment; M. Blazquez, INOKA SISTEMAS / RTD; O. Andreu-Sánchez, Xenobiotechnics; A. Bermejo-Nogales, M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment

The USE-TCOMBASE project main target is to promote the sustainable use of biocidal active substances by developing prediction models. As a first step, a database compiling aquatic toxicity data to the aquatic compartment for biocides and derived metabolites has been implemented. The aim of the present study is to make a critical review of this information in order to have a wide view about their potential risk for the aquatic compartment. All the biocides approved and under review were compiled (277 active substances; Regulation (EU) 528/2012). A selection of 192 biocides with possibilities to be modeled and a search using several official and scientific databases, looking for any possible metabolite derived from their release in the aquatic compartment were done. Data was collected in an excel file, including identification of the biocide or metabolite (EC NR, CAS NR, SMILES), classification data (main group, product type, regulatory status), LogP, half-life, and the acute toxicity for invertebrates, algae and WWTP microorganisms. The EU Regulation (EC) No 1272/2008 on classification and labeling was considered to group these compounds in four toxicity categories taking into account the values of NOEC or LEC50; 1 (≤ 1 mg/L), 2 (1>1 to ≤ 10 mg/L), 3 (10>10 to ≤ 100 mg/L) and 4 (>100 mg/L). Most of the found data was related to toxicity in fish, followed by invertebrates and algae, mainly marine organisms being the least studied. There was not reported data for around 18% of the 185 metabolites found, probably due to, in some cases, their commercial unavailability. Another identified problem was that some data were developed with formulated products or with active substances for which purity was not reported. Data already analyzed for the acute toxicity indicated that, 62% of the biocides were located in category 1 for invertebrates, 54% for fish and 52% for algae. Only 2-3% of biocides belong to this category for the microorganisms group. Metabolites are mainly less toxic than the parent biocides, however many of them present the same toxicity and very few (<7%) are more toxic. The ongoing work indicates that biocides and a considerable percentage of their metabolites present a high toxicity for the aquatic species. It also identifies data gaps related to the ecotoxicological potential for metabolites.

Acknowledgements: LIFE-TCOMBASE project (LIFE15 ENV/E000416).


Imposex is a TBT-induced feminization of marine male sex-characters in female dogwhelk (Nucella lapillus). This biological effect is quantified by the Vas Deferens Sequence Index (VDSI). Levels of imposex and TBT in N. lapillus have been monitored annually in Norway since 1991. Populations around the North Sea were critical reduced in the 1990s, due to increased use of TBT-based antifouling paints. Before the global TBT-ban in 2008, increased TBT-levels coincided with increased imposex prevalence at many monitoring sites located close to high maritime activity. After 2008, decreasing TBT-trends at former impacted sites, lead to population recovery of N. lapillus. The observations in N. lapillus further corroborated by monitoring data showing decreased TBT levels in blue mussel (Mytilus spp.). This monitoring data confirm the rationale of implementing strict antifouling regulations on industrial chemicals when this can be linked to ecological perturbations in coastal ecosystems. The TBT/imposex monitoring was conducted at eight coastal stations representing the Norwegian coast from the Oslofjord to the Varangerfjord, following the guidelines given by OSPAR and ICES. Subsequently, 50 specimens from each station was analysed individually for imposex/VDSI and pooled (only females) for TBT and other organotin like (TPT/TIN). The worms (VDSI ≤ 0.3 µg/kg w.w.) were low in N. lapillus at eight stations in 2015. At most stations, VDSI was 0 or close to 0 and below the OSPARs Background Assessment Criteria (BAC=0.3). The highest level (VDSI=0.828) was found at the shipping channel Karmсудet, which were above BAC but below the OSPARs Ecotoxicological Assessment Criteria (EAC=2). There were significant downward long-term (whole period 1991-2015) and short-term (recent 10 years 2006-2015) trends for both imposex/VDSI and TBT based on time trend analysis. These results show that the Norwegian legislation banning use of TBT on boats less than 25 m in 1990, on larger ships internationally from 2003, and the total ban in 2008 have been effective
in reducing imposex in *N. lapillus* and have re-established some of the populations. Low levels or significant downward long-term and short-term trends for TBT in common periwinkle (*Littorina littorea*) and blue mussel (*Mytilus spp.*) substantiate this.

**MO381 Risk assessment issues for algacides under BPR**

C. Durou, M. Darrriet, J. Rivera, CEHTRA SAS

A prospective and comprehensive environmental risk assessment (ERA) must be performed on the active substance for the market authorisation of biocidal products. The technical guidelines are made publicly available by ECHA. The data required for the ERA include the determination of a set of properties (physical-chemical, fate properties, short-term and long-term ecotoxicity), an effective in-use dose or concentration, frequency of application of the biocidal product etc… In coming years, a prospective risk assessment has to be prepared in order to address the risk associated with the use of biocidal containing these active substances and also any substance of concern. The initial approach for a prospective environmental risk assessment will proceed with a Tier 1 calculation, which assumes 100% of the applied chemical will be released and ignores the formation of degradation products neither biodegradation of the active substance, neither consumption of active substance due to its biocide activity. These initial assumptions may lead to an overestimation of the environmental exposure and risks to the active substance. The initial environmental risk assessment can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk management measures e.g. measures against misuse. An important aspect here is that active substances applied to swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algacide applied in swimming pools. The poster will focus on following key points: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of environment including new studies and risk management measures.

**MO382 Could a spatially distributed modelling approach enhance post approval considerations for veterinary medicines?**

C. McMillan, G. Hughes, J. Carnall, Cambridge Environmental Assessments

Tiered chemical risk assessment framework adopted in Europe for assessing the surface and groundwater risk from veterinary medicines used to treat livestock follows a tiered approach. The initial exposure assessment is a simplistic approach, with the FOCUS suite of models (FOrum for Co-ordination of pesticide fate models and their Use) often subsequently required for higher tier surface and groundwater refinement. Standard FOCUS scenarios defined within the guidance are intended to represent worst case scenarios for assessing the leading behaviour. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algacide applied in swimming pools. The poster will focus on following key points: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of environment including new studies and risk management measures.

**MO384 Veterinary medicine products (VMPs) are used in livestock production to preserve animal health or to promote growth in certain categories of animal; feed additives (FAs) are products aimed at improving the quality of feed and the quality of food from animal origin, or to improve the animals’ performance and health. These substances may not be put on the market unless authorisation has been given following a scientific evaluation demonstrating that they have no harmful effects, on human and animal health, on the environment. In particular, according to European Framework Directive 2001/82/EC, the environmental risk assessment (ERA) procedures for VMPs are based on technical guidance documents which propose a tiered approach to calculate PECSoil and PECgw of VMPs from livestock manure spread on the field. On the same way, the ERA procedure for feed additives is reported in a technical guidance document from EFSA which describe a two-tiered approach to calculate PECSoil and PECgw from spread manure. Calculation of PECSoil proposed by the two ERAs in the first tier is directly related to the “annual nitrogen (N) inmmission standard” which is the amount of nitrogen per Hectare spread on or into the field. Both ERAs propose a default value of 170 kgN Ha⁻¹ which is the maximum allowed annual amount of nitrogen originating from animal manure on a farm within nitrate vulnerable zones (NVZ). On the other side, in Europe, NVZs are measured in % of the area where farming is done and in several zones higher thresholds of N immission standard are allowed. Both ERAs procedures could therefore underestimate the PECSoil with a potential environmental toxicity for non-target terrestrial organisms. This study is aimed to evaluate if PECSoil, calculated using standard models currently used in the authorisation procedures of VMPs and FAs, are sufficiently adequate to protect soil and groundwater from contamination or surface water risk. In this presentation we consi...
Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information (P)

MO387  
Recommendation on Steam Cracker allocation for the sake of comparability of petrochemicals products datasets used in LCA studies

G. Castelan, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different molecules; ethylene, propylene, toluene, benzene, xylene, etc. They are all basic building blocks of many chemicals and polymers used in nearly all products and sectors. Thus LCA data of steam cracker products directly influence a huge amount of further downstream products. It is therefore important that LCA data for steam cracker products are modelled consistently, enabling a reduction of uncertainty and a better interpretation by LCA experts, particularly in perspective of comparability, in LCA studies of these downstream products. Basing on ISO 14044 and on the abundant existing literature on this topic the Life Cycle Thinking and Sustainability working group of PlasticsEurope, composed of experts from its member companies, plus some experts of the Chemical Sector of the World Business Council for Sustainable Development, and some LCA consultants have issued a recommendation built through a consensus 5 years long process. The presentation will elaborate on the discussions and on the recommendation finally issued, considered as the best compromise between comparability and specific representativeness. For multi-output processes, such as a steam cracker, ISO 14040 and 14044 standards define a hierarchy of several options. Due to the nature of steam cracker processes allocation is considered as the preferred option. The concept of defining a main “products” fixed list in combination with a mass-based allocation for steam crackers has led to a consistent LCA approach, independent from market prices, technological changes or market driven adaptations of steam cracker outputs. It gives practitioners a clear guidance for the allocation process. This results in less differing environmental data for steam cracker products and will lead to a higher comparability. The results are much more stable, although the same product will have slightly different LCI results depending on different amounts of products derived from the steam cracker. Such a collaborative work towards streamlining should be engaged for all chemicals, and should be applied within all database both to background and foreground parts, like for example in the European EF compliant database.

MO388  
Actual versus default uncertainty in ecoinvent database

F. Belizario, L.A. Oliveira, Institute for Technological Research IPT; M.R. Saade, V. Gomes, University of Campinas UNICAMP; M.G. Silva, Federal University of Espirito Santo; G. Moraga, Universidade Federal do Rio Grande / NORIE; A.B. Passuello, Federal University of Rio Grande do Sul; V.M. Jahn, University of São Paulo USP; O.S. Yoshida, Institute for Technological Research IPT

Variability of national life cycle inventory flows is a relevant uncertainty source and should be properly informed in public databases. Within the scope of the Sustainable Recycling Industries project, life cycle inventories for Brazilian construction products were developed and submitted to ecoinvent following its guidelines, including the preferred use of the lognormal distribution for uncertainty modelling, which requires converting sample average and variation into the geometric mean and the unbiased variance of the underlying normal distribution. However, dataset reviewers inform that most data providers do not perform these conversions and simply use the sample average for flow amounts, frequently associated to default basic uncertainty factors suggested by ecoinvent. This work discusses the implications of three different uncertainty modelling approaches: 1) using both converted mean and variance, 2) using the sample average with the converted variance; 3) using the sample average and default basic uncertainty variance (probably the most common approach). Primary data collected in 25 concrete block factories were used in the analyses. Influence on life cycle impact assessment results was assessed using Monte Carlo simulation with 10,000 iterations, CML 1-A method and ecoinvent v.3.2 “Rest of the World” datasets for upstream processes. Results show that the sample weighted average and the geometric mean differed significantly. Therefore, using the sample weighted average as a proxy for the lognormal geometric mean may overestimate impacts, in our case by approximately 10%, considering only the effects of the concrete block production process flows. Since existing databases may have followed this approach, the modelled impact may be higher than expected. Moreover, basic uncertainty values are significantly lower than measured variations across manufacturing sites, which is inconsistent with a conservative estimation approach. Thus, uncertainty information provided by ecoinvent might contain inconsistencies and leads to errors in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount parameters, performing automatic conversions in the submission software or simplifying the provision of uncertainty data using simpler probability distributions.

MO389  
Life cycle assessment of battery systems with harmonized life cycle inventories considering different storage applications

X. Zhang, Paul Scherrer Institute / Laboratory of energy systems analysis; C. Bauer, Paul Scherrer Institute / Laboratory for Energy Systems Analysis; T. Terlouw, Utrecht University / Copernicus Institute of Sustainable Development; M. Beuse, ETH Zurich / Energy Politics Group, Department of Humanities, Social and Political Sciences

The penetration of renewable electricity has greatly increased in the past decade. Battery is a key storage technology to balance supply and demand and to facilitate the world’s transition towards a sustainable energy system. However, having a comprehensive overview of batteries’s life cycle environmental performance still remains a challenge, because battery technologies are of various kinds and the applications of batteries vary. These applications are different from each other in terms of required power and energy size as well as number of cycles. Due to these different requirements by applications, the same battery technology needs to be operated differently and sized accordingly. Numerous studies in the past investigated the life cycle environmental performance of batteries; however, most of them are focused on the application of batteries in electric vehicles, considering a limited number of lithium-ion battery technologies, while the stationary applications of batteries were less explored in limited studies. In addition, these studies are mostly conducted based on diversified sources of life cycle inventory data, without harmonizing the assumptions that are not necessarily different. Peters et al. have recently applied in real scale, the application of novel 4-terminal battery systems, but they are compared without considering the applications. Another study by Baumann et al. considered the applications of battery in the assessment, without addressing the country of application, which results in partial understanding of contributions in the life cycle emissions. This study therefore addresses these challenges, by considering six battery technologies for five storage applications in three representative applications in Europe. On this comprehensive basis of studies, the harmonization of inventory data is carried out to a greater extent. We also extend the scope of the system, which is often limited to battery pack, to include the complete balance of systems, which ensures the operation required by the applications. 

MO390  
LCA of nano-adsorbents - Interpretation of laboratory results

A. Kazemi, Tarbiat Modares University / Department of Environmental Science, Faculty of Natural Resources; S.I. Olsen, Technical University of Denmark / DTU Management Engineering Division for Quantitative Sustainability Assessment; N. Bahmanzadeh, Tarbiat Modares University / Department of Environmental Science, Faculty of Natural Resources; A. Heydari, Tarbiat Modares University Nano-adsorbents as an emerging product and a special application of nanomaterials can increasingly play an important role in the control and removal of environmental pollutants. An example of this is the use of nano-iron to remediate contaminated groundwater. However, even though particularly this example has been recently applied in real scale, the application of nanoparticles as adsorbents is still an emerging technology at the early stages of development. Hence, this study enables an environmental assessment of nano-adsorbents as an emerging product/technology based on the results from the laboratory. Two nano-adsorbents with graphene-based (MGO-NH-SH) and Fe₃O₄-based (Fe₃O₄@SiO₂-NH-SH) composites, which function with a similar thiol group for Hg(II) removal are compared at different stages of the production. Removal of mercury is important due to its historic cases of fatal contamination and its continued use. Although mercury must be removed from the contaminated sites it is still very relevant to make an LCA in order to ensure a balance between the impacts of producing the nanoadsorbent versus the avoided impact of the mercury that is being removed. The environmental impacts of synthesised adsorbents including energy use, climate change, water use, human toxicity, and ecotoxicity are investigated by a stepwise procedure during their synthesis processes, regarding their potential to remove mercury from polluted water (functional unit is removal of 1 kg of Hg(II)). Accordingly, characterization results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of the adsorbents, it is also associated with a significant enhancement of negative environmental impacts. A “what-if” perspective was applied to address the uncertainties of using lab-scale data for parameters including amounts of acid (HCl + H₂SO₄), ammonia, ethanol, methanol, DCC (N,N'-dicyclohexylcarbodiimidine), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of the test comparing the impacts between MGO-NH-SH and Fe₃O₄@SiO₂-NH-SH estimated respectively 37, 34, 40, 31, and 26% more climate change, water use, energy use, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis was employed to determine the uncertainties for scale-up production and it is shown that especially potential reductions of electricity use, ethanol and DCC can reduce the impacts significantly.

MO391  
Quantifying the influence of consumer behaviour on water, energy and greenhouse gas footprints of showering

S. Shahmohammadi, Radboud University / Environmental Science; Z. Steinmann,
Radboud University Nijmegen; H. King, Unilever; H. Hendricks, Unilever RD Colworth; R. University, Radboud University Nijmegen / Department of Environmental Science

Life Cycle Assessment (LCA) has been used as a tool for environmental footprinting of a wide range of household cleaning activities. Even though differences in the way household activities are performed by consumers may alter the outcomes of LCA, the variability in consumer behaviour is generally ignored in LCAs, which use the average behaviour as a basis for quantifying the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ reasoned choices, consumers’ habits, climatic parameters, manufacturing of products and infrastructure of countries can be combined to quantify the variability in the energy use, greenhouse gas emissions and water footprints related to the life cycle of showering. The model of showering were modelled in 4 countries namely Australia, Switzerland, the United Kingdom and the United States using various data sources to quantify the associated variability. Results showed that both inter-country behavioural, climatic and infrastructural differences as well as intra-country variation in consumer behaviour are crucial for determining the variability in the life cycle environmental impacts. Inter-country variability - the ratio between the highest median footprint and the lowest median footprint over the four countries- in the 4 main output variables of the model i.e. energy use, GHG emissions, water withdrawal, water consumption and water scarcity was a factor of 1.5, 2.2, 1.4 and 5.8 respectively. Intra-country variability - the ratio between the 95th percentile and the 5th percentile of the distribution- was typically higher than inter-country variability and ranged between factors of 5 and a factor of 20 depending on the process and indicator considered. Sensitivity analysis showed that consumers’ reasoned choices - particularly heater type and shower flow rate- and their habitual behaviours - particularly shower duration-, are the dominant sources of variabilities. Reductions in the water and energy related impacts of showering through changing of reasoned choices are achievable by one-off decisions such as buying an energy efficient water heater. However, reducing the impacts through changing of consumers’ habits could be challenging and needs more systematic approaches as consumers tend to keep their old habits.

MO394 Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments

Nanomaterials of the OECD Sponsorship Programme, namely Ag-212 (CeO2) and NM-300K (Ag), were used for the experiments. Two concentrations for each CeO2-NM and Ag-NM were applied via sewage sludge into the top 20 cm of lysimeter soil. In addition, CeO2-NM were applied via simulated rainfall over four weeks on the surface of the lysimeter soil and afterwards mixed into the top 20 cm to simulate ploughing. Subsamples of the soil were incubated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity. The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, canola and barley indicates that the chemical conditions in the rhizosphere induce Ag-NM remobilization from the incorporated sewage sludge even after three harvesting cycles. The CeO2-NM did not induce any adverse effect on the investigated soil microorganisms and the plant growth. At the higher Ag-NM concentration, a constant inhibition of the soil microflora (ammonium oxidizing bacteria and substrate-induced respiration) was observed over about 3 years in the lysimeter study. However, there was no effect at the lower Ag-NM concentration. The over years. Ecotoxicological results of the laboratory experiment over 180 days reflect the findings of the lysimeter study. For Ag-NM and CeO2-NM the results indicate that a hazard assessment based on data from laboratory tests is acceptable.

MO395 Long term effects of three different silver sulfide nanomaterials, silver nitrate and bulk silver sulfide on soil microorganisms and plants

Silver nanomaterials (AgNMs) are subjected to various transformations along their way into the sewage treatment plant (STP). Hereby the AgNMs are mainly transformed to silver sulfides (Ag2S) (Kaegi et al, 2011). Sparingly soluble Ag2S is considered as non toxic to soil organisms. In the STP the AgNMs adsorb to sewage sludge (Schlich et al, 2013) and the arising biosolids will be applied in large quantities on agricultural land within the European Union. The main goal of the present study was to determine, if different types of sulfidized AgNMs evoke a
difference in the toxicity of the AgNMs. A realistic exposure scenario was chosen. The five test materials NM-300K, previously sulfidized NM-300K, a nanoparticulate Ag$_2$S, and bulk Ag$_2$S were added with an influent concentration of 1 mg/L and AgNO$_3$ with an influent concentration of 0.5 mg/L into the denitrification of a simulated STPs continuously for 10 days. The sewage sludge of each treatment was dewatered and the biosolids were mixed with soil. After 0, 60, 90, 120, 150 and 180 days of exposure, the earthworms were sampled over time for the available energy reserves (total lipid, sugar and protein contents), energy consumption (measured at both the cellular level and as the whole animal respiratory rate) and internal Zn concentrations. The earthworms were exposed to ZnCl$_2$ or Zn nanoparticles (ZnO-NPs) in Lula 2.2 soil for 21 days (uptake phase), followed by 14 day elimination phase in clean soil (in vivo, whole organism). Two treatments were used for both ZnCl$_2$ (250 and 500 μg Zn g$^{-1}$ dry soil) and ZnO-NPs (500 and 1000 μg Zn g$^{-1}$ dry soil), corresponding to EC$_{10}$ and EC$_{50}$ for reproduction, plus control without added Zn. The results suggest that the earthworms are able to regulate internal Zn concentrations efficiently, regardless of its form and concentration, and any serious impact on their energy reserves. Sugar content was the only energy reserve component which was significantly lower in 1000 ZnO-NPs than control (p<0.03) in the uptake phase. The total available energy reserves (Ea) and protein contents did not differ significantly between treatments but significant effect of day of exposure was found (p<0.0003). Neither treatment nor the exposure day affected the lipid content in the uptake phase. In the elimination phase, no treatment or time of elimination had an impact on Ea or protein contents. The whole-organism respiration rate (measured as oxygen consumption) was not affected by Zn treatments in any of the two toxicokinetic phases. The results for the whole organism respiration rate will be additionally compared with those for the respiration rate measured at the cellular level as an electron transport activity, which is probably more prone to rapid temporal changes in conditions - as is the case for most biochemical biomarkers. The relationship between the two endpoints (Ea and protein contents), which individuals were sampled over time for the available energy reserves (total lipid, sugar and protein contents), energy consumption (measured at both the cellular level and as the whole animal respiratory rate) and internal Zn concentrations will be discussed. This study was supported by the National Science Centre, Poland (2015/17/N/ZN8/01576).

MO399 Evaluating the Cellular & Humoral Immune Responses of the Terrestrial Isopod, Porcellio scaber, to Gold Nanoparticles C.A. Mayall, University of Ljubljana, Biotechnical Fac. / Biotechnical Faculty; D. Drobnic, University of Ljubljana / Department of Biology Gold nanoparticles are popular due to their stability, the ease with which they can be synthesised and the myriad of potential uses they could have, which includes drug delivery systems, cancer therapy and biosensors. It is inevitable that these new metal nanoparticles (NPs) will find their way into the environment and therefore the possible effects they could have need to be evaluated. In particular, it is anticipated that organisms may recognise NPs as “foreign” and respond by modulating their immune system. To date, only a few studies have dealt with this issue. The aim of this study was to investigate the recognition of gold nanoparticles by the terrestrial isopod, Porcellio scaber. These organisms are well-studied and have previously been used as models for environmental toxicity. As the immune system is an early responder to foreign matter, studying it in conjunction with traditionally used parameters of toxicology can give more information into the possible effects these particles may have. This study used two types of particles - one with an Au core and another with a PVP coating, both of which were approximately 26nm. For the ingestion route, animals were fed gold NPs for 14 days. During this time the feeding, defecation and survival rates of the animals were recorded. After 14 days, hemolymph was removed and the number, viability and proportion of hemocytes were counted. Along with the cellular tests, the humoral side of the immune system was investigated by measuring the activity of the phenoloxidase, which is associated with melanisation and wound healing, in the hemolymph. The levels of immune markers, glutathione S-transf erase and soluble acetylcholinesterase, were also assayed. As the gut is thought to impede the NPs’ ability to journey into the

MO398 Energy reserves and respiration rate in the earthworm Eisenia andrei after exposure to zinc in nanoparticle or ionic forms Z.M. Swiatek, Institute of Environmental Sciences, Jagiellonian University / Institute of Environmental Sciences; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation The energy budget is an indicator of the organisms’ overall condition and the changes in the energy reserves and/or energy consumption rate have been used as biomarkers of toxic stress. To understand better the effect of different forms and concentrations of Zn and possible costs connected with the effective Zn regulation by the earthworm Eisenia fetida, a study was performed where the same NPs in simulated in vitro invertebrate digestive juice and assessed the dissolution rate using (sp-)ICP MS. A preliminary data show that there are mostly inorganic in the digestive glands, but NPs were also detected when the animals were exposed only to solution. This points to the formation of secondary NPs inside the organism. In vitro digestive juice model does not entirely represent the expected dissolution rate of NPs that was concluded from in vivo exposure. The usefulness of terrestrial isopods as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

MO397 Terrestrial isopods as models to assess the biotransformation of nanoparticles inside the organisms: an example with silver and gold nanoparticles A. Jeneec Kokali, University of Ljubljana, Biotechnical Fac. / Department of Biology, van der Linden, University of Ljubljana / Department of Environmental Sciences; I. Lynch, University of Birmingham / School of Geography, Earth and Environmental Sciences; S. Novak, University of Ljubljana / Biotechnical Faculty; D. Drobnic, University of Ljubljana / Department of Biology Physico-chemical properties of nanomaterials, such as their size, shape and dimension, depend on their environment. Most commonly anticipated alteration of metal based nanoparticles is their dissolution and alteration in size, which are interrelated. Our previous in vivo studies with crustacean isopod Porcellio scaber have shown that the dissolution of some metal nanoparticles (NPs), such as copper oxide and silver NPs, drastically increase inside the animals. These in vivo studies were typically the 14 days feeding experiments and afterwards the total metal content (both NPs and metal ions) was analysed in digestive glands of the animals. With the advancement of analytical techniques, such as single particle (sp-)ICP MS, it is now possible to analyse only the NPs content in the digestive gland and distinguish the signal from metal ions. This also enables to proof whether NPs are

MO395 Influence of soil type on the toxicokinetics of Ag and Ag$_2$S nanoparticles and ionic Ag in soil invertebrates C. van Gessel, Vrije Universiteit Amsterdam / Ecological Science The rise of nanotechnology and the increased use of nanomaterials in consumer products may lead to an increased emission of nanoparticles (NPs) to the environment. Since NPs may leach from products during use, waste water treatment plants (WWTPs) may be an important sink but also an important source of NP emission to the environment. The use of sewage sludge in agriculture may, for instance, lead to NP exposure in soils. NPs may undergo transformation when passing WWTPs, with sulphidation being an important process. Silver nanoparticles are among the most used, suggesting that Ag-based NPs also will be among the NPs most likely ending up in soils. And considering the transformation processes taking place in the WWTP, Ag$_2$S may be a form in which the NPs likely will reach the soil. In soil, sorption, aggregation and dissolution processes will determine the availability of the NPs or released ions for uptake by organisms. Bioavailability will also depend on soil properties that play an important role in governing NPs transformation. In this study aimed at assessing the influence of soil type on the bioavailability of Ag and Ag$_2$S NPs to enchytraeids (Enchytraeus crypticus) and springtails (Folsomia candida). Four soils with different pH (4-7), organic matter (2-17%) and clay contents (3-13%) were used. An uptake and elimination kinetics approach was taking, in which the animals were exposed to a single concentration (nominal 10 mg Ag/kg dry soil) for 14 days (uptake phase), after which they were transferred to clean soil for a 14-day elimination period. A first-order one-compartment model was used to calculate uptake and elimination rate constants. Results for the enchytraeids showed k1 values for the uptake of Ag ranging between 0.009 and 0.057 g soil/g animal/day for Ag$_2$S and of 0.107-0.671 g soil/g animal/day for AgNO$_3$. These data suggest a lower availability of the Ag from the Ag$_2$S NPs than from the ionic Ag. The k1 values for the Ag$_2$S NPs were different for the different soils, with highest values for AgNO$_3$. Where lowest availability was expected in the soil with the highest cation exchange capacity (CEC), this indeed was the case for AgNO$_3$, but not for for Ag$_2$S. Elimination rate constant values (k2) ranged between 0.057 and 0.565 per day, and were not dependent on soil type or Ag form. Tests on the springtails are still running.
hemocoe, isopods were injected with gold NPs and then left for 48 hours to recover from the injection; in previous experiments 48 hours was shown to be enough time for hemocyte numbers to return to pre-injection levels. The total number of cells, viability and the proportion of hemocyte types were counted. These counts were then compared to the animals which had been fed NPs and to others that had been injected with a non-lethal dose of LPS. Preliminary data shows that the isopods cellular immune response is altered upon direct injection of NPs, but no such effect was found after their ingestion. The study is still ongoing.

MO402 Toxic Effects of Silver Nanoparticles and Its Transformation Product in Soil Applied with Biosolid

E. Topuz, I. Koyuncu, Istanbul Technical University / Environmental Engineering Biosolids, which are produced as a result of biological wastewater treatment, need to be managed as a separate waste category. Land spread of agricultural land, as a resource of nutrients and organic matter, is encouraged under the “Resource Efficiency Roadmap of Europe” [1]. However, the presence of contaminants in biosolids such as engineered nanoparticles can cause concerns. Total Ag concentrations in biosolids can be up to 195 mg Ag/kg dry soil in biosolids according to Johnson et al. [2] which is close to observed EC50 concentrations of AgNPs (AgNPs) [3]. Moreover, AgNPs are mostly transformed to Ag2S sulfide nanoparticles (Ag2SNPs) due to the reductions conditions present in the wastewater treatment plant (WWTP) [4]. Recent studies suggest the possibility of AgNP residues because of the partial sulfidation of AgNPs [5]. Land spread of biosolids might lead to the transfer of AgNPs and Ag2SNPs to the soil which could pose harm to soil organisms. Hence, this study aims to investigate the toxic effect of AgNPs and its transformation product, Ag2SNP, on soil ecosystem in the case of their spread via biosolids application. Polyvinylpyrrolidone coated AgNP (AgNP-PVP) and AgSNP are tested in order to investigate their possible different effects on the survival and reproduction of Enchytraeus fetida

short-term induced molecular stress responses in coelomocytes of Eisenia fetida earthworms in vivo exposed to silver nanoparticles

s. curieses, CONICET PRIET UELU; N. Garcia Velasco, E. Unihanarentxea, University of the Basque Country UP/EHU; M. Saez, PRIET CONICET, National University of Luján; M. Soto, University of the Basque Country UP/EHU; W.D. Di Marzio, CONICET-PIRET / PRIET

In recent years the production of nanoparticles (NPs) has increased massively. The subsequent release of NPs into the environment has been assessed to assess the potential ecological risk in soil, water and air. Silver nanoparticles (Ag-NPs) have the highest degree of commercialization due to their high thermal and electric conductivity, high catalytic activity, and powerful antimicrobial properties. Eisenia fetida is a model specie in soil toxicity studies and has been broadly used due to its sensitivity to different toxicants at different levels of biological organization. The main aim of the present investigation is to understand the effects produced by AgNPs (5.082±mm size and PVP-PEI coated) in comparison with the soluble form of the metal (AgNO3) at molecular level in coelomocytes of E. fetida at different exposure times. E. fetida were in vivo exposed to different concentrations of Ag-NPs and AgNO3 (0.05 and 50 mg Ag/kg soil) through OECD artificial soil and biosolids might lead to the transfer of AgNPs and Ag2SNPs to the soil which could pose harm to soil organisms. Hence, this study aims to investigate the toxic effect of AgNPs and its transformation product, Ag2SNP, on soil ecosystem in the case of their spread via biosolids application. Polyvinylpyrrolidone coated AgNP (AgNP-PVP) and AgSNP are tested in order to investigate their possible different effects on the survival and reproduction of Enchytraeus fetida - 228 - SETAC Europe 28th Annual Meeting Abstract Book
significant induction of CAT at day 1, followed by an increase in its transcription levels after 3 and 14 d of exposure. Similarly, exposure to AgNO₃ induced the transcription of CAT at day 1 but at day 14 a downregulation was observed. The CAT activity increased at both treatment and exposure times (1 and 3 d). After 14 d of exposure, CAT activity was inhibited at the highest concentration tested. The highest increase of MTs at protein level was observed after 3 d of exposure. Our results indicate that short-term exposures to Ag NPs induced early molecular stress responses (MT induction and oxidative stress) in coelomocytes that precede other responses at higher levels of biological organization. The responses in transnational level in *E. fetida* tissues were according. The study indicates the importance of using integrative biomarkers for the evaluation of the potential risk of Ag NPs in soils.

**MO404**

**Effects of Cerium Nanoparticles with deferent surface-charge in coelomocytes of *Eisenia fetida***

s. curies, priet conicet; O. Tsyusko, University of Kentucky, Department of Toxicology and Chemistry; M. Saenz, PRIET CONICET, National University of Luján; W.D. Di Marzio, CONICET-PIRET / PRIET; j. urrine, University of Kentucky, Department of Toxicology and Cancer Biology

With the rapid development of nanotechnology and its broad applications, a wide variety of engineered nanoparticles are used in commodities, pharmaceutics, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO₂-NPs) are used as a modifier of Titanium dioxide (TiO₂) for different purposes and as chemical-mechanical planarization agents in production of silicon wafers. This study investigated the toxicity of CeO₂-NPs with polymer coatings in of different charge in coelomocytes of *Eisenia fetida* earthworms. The CeO₂-NPs (2.5 nm primary particle diameter) were coated with dextran to confer a neutral charge (DEX-CeO₂ (0)), diethylaminoethyl dextran to confer a positive charge (DEAE-CeO₂ (+)) and carboxymethyl dextran to confer an negative charge (CM-CeO₂ (-)). The range of exposure concentrations were 0.02-1562.5 mg Ce/L. The coelomocytes were ex situ for 1 h for each treatment. Then, the transcriptions levels of genes associated with stress (catalase and heat shock protein 70) were determined by q-RT-PCR. In addition, cytotoxicity and genotoxicity were determined by using tripan blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DEAE-CeO₂ (+) were more toxic than negative and neutral CeO₂-NPs. The results show that initial surface chemistry had a profound impact on the toxicity of CeO₂-NPs to coelomocytes.

**MO405**

**The uptake of pristine and aged silver nanoparticles by wheat, Triticum aestivum, in a soil exposure***

A. Green Etahbe, CEH Wallingford; C. Schultz, Centre for Ecology and Hydrology; D. Tarnovska, M. Matzke, NERC Centre for Ecology and Hydrology; D. Spurgeon, Centre for Ecology & Hydrology; C. Svendsen, CEH, Wallingford / Pollock College, University of Reading / Centre for Agriculture and the Environment

It is expected that most nanoparticles (NPs) which reach the soil will not be in their pristine form but instead will have been transformed by the environment (e.g. sulphidisation of Ag in waste water treatment processes). This will greatly influence the form of NP to which soil organisms are exposed and their ultimate bioavailability. The bioaccumulation of NPs inside the organisms can govern their fate and transformation in the environment; and uptake studies can give insight into how organisms act as sources and sinks for NPs in food webs. Most data currently available are for pristine Ag NPs, and consequently the difference in the bioavailability of the aged forms, predominantly Ag2S, is uncertain. The aim of this study is to compare the uptake kinetics of Ag NPs, both pristine (PVP coated Ag NPs, 20 and 50 nm) and aged (Ag2S, 20 nm), in the crop species, wheat, *Triticum aestivum*. Wheat plants were exposed from seed to each of the NPs at two nominal concentrations of Ag, 3 and 10 mg Ag/kg, in the soil Lufa 2.2. Samples were collected at five time points over the 42 day post-emergence exposure period. The growth rate, Ag accumulation and the translocation from root to shoots were determined. The toxicokinetic parameters of the Ag uptake in the roots and shoots were calculated using total soil concentration and soil pore water concentrations as metrics of exposure. Pore water was collected at all sampling points and at the end of the exposure period pore water was ultra-filtered as a measure of the dissolved Ag in the pore water. The accumulation of all silver forms was greater in the roots, with only a small fraction transported to the shoot. The uptake of Ag2S was lower compared to pristine Ag particles but there was no difference between the uptakes of the two pristine Ag particles. This study shows that environmentally relevant forms of Ag NPs are bioavailable to plants and show different uptake kinetics than the pristine forms.

**MO406**

**In vitro effects on Dendrobaena veneta coelomocytes of Ag and TiO₂ nanoparticles before and after wastewater treatment processes***

A. Georgantopoulou, Norwegian Institute for Water Research NIVA; C. Coutriis, Norwegian Institute of Bioeconomy Research NIBIO / Dpt for Soil Quality and Climate; K. Nndug, Norwegian Institute for Water Research; P.A. Carvalho, SINTEF Materials and Chemistry; A. Almeida, Norwegian Institute for Water Research NIVA; A. Macken, NIVA / marine pollution

The majority of nanomaterials (NMs) used in commercial applications are likely to enter the wastewater stream and reach wastewater treatment plants. In many countries, wastewater effluent and sewage sludge are discharged in aquatic environments or applied on agricultural land, however, the transformation of the particles and the potential environmental impacts of NMs are still poorly understood. Recent studies have shown high association of NMs with sewage sludge, therefore soils can be a sink for NM pollution making terrestrial organisms vulnerable. The main aim of the study is to understand the transformation of NMs during wastewater treatment processes and to evaluate the potential environmental hazard of aged particles compared to pristine Ag. In this study, coelomocytes (primary immune cells) isolated from the epigeic earthworm *Dendrobaena veneta* are used as a model to assess the effects of Ag and TiO₂ NPs. Initial investigations focus on Ag (PVP coated, 25 nm, nanoComposix) and TiO₂ particles (uncoted anatase, nominal primary size of 5 nm, NM-101, JRC) and their mixture, to better understand their uptake, interaction with coelomocytes and subsequent cellular effects. Moreover, a lab-scale wastewater treatment system is used to study the transformation of Ag and TiO₂ NPs through biological wastewater treatment processes, and the potential effects of the aged particles through biosolids application is evaluated. Extensive characterization of the particles in exposure media is performed with dynamic light scattering (DLS), single particle Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM). Moreover, nanoparticle uptake and intracellular localisation are evaluated with TEM and sp-ICP-MS.

**MO407**

**Differential biomarker responses of Daphnia magna to pristine and wastewater borne silver nanoparticles***

V. Galliano, Department of Biology & CESAM - University of Aveiro / Biology and Environment; J.R. Monteiro, Agrozoom University of Aveiro / School of Science of Agriculture; M. Cuperlo, University of Siena / Department of Physical, Earth and Environmental Sciences; M. Lopes, University of Aveiro / Department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM; 3810-193 Aveiro

The long term use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater borne AgNPs (25 and 125 µg/L) on biological markers of neurotoxicity and anti-oxidative stress in *Daphnia magna*. (14 d-old) were exposed to 25-125 µg/L of NM-300K for 96 h in a WWTP effluent or in ASTM medium. Daphnids were analysed for changes in acetylcholinesterase (AChE), glutathione S-transferase (GST), catalase (CAT), lactate dehydrogenase (LDH) activities, and lipid peroxidation (LPO). Results showed a significant increase of CAT activity in effluent exposed samples compared to ASTM control, thus suggesting induction of oxidative stress by effluent. The dispersant used in ASTM (4% w/v of each Tagat® TO and Tween® 20) showed both significant decreases (AChE, GST, CAT) and increase (LDH) of enzymatic activities in dispersant-control relatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent compared to negative-control comparatively to ASTM, especially for higher concentrations. There was a significant decrease of AChE activity in effluent (25 and 75 µg/L) and ASTM (125 µg/L) media, which implies impairment of control and modulation of neural transmission signal in these experimental conditions. The significant increase of GST and CAT activities at 100 and 125 µg/L in effluent, respectively, suggest oxidative stress. The significant increase of LDH activity in effluent at 25 and 125 µg/L in effluent suggests an increase in anaerobic metabolism and higher stress for daphnids. Unexpectedly, there was a significant decrease on LPO at 125 µg/L in ASTM, which could be explained by a decrease of synthesis of total lipids. This study shows that (i) the response of biomarkers to used dispersing agent highlights the need for further study on its effects in organisms prior to its application, in order to understand the AgNPs behaviour in standard test media and (ii) there is a distinct biomarker response-pattern in daphnids exposed to WWTP effluent containing NM-300K and ASTM supplemented with pristine NM-300K. In

**MO408**

**Outlining the behaviour and ecotoxicology of biomedical nanoparticles in natural waters***

G. Grassi, M. Cuperlo, University of Siena / Department of Physical, Earth and Environmental Sciences; D.R. Hristov, University College Dublin / School of Veterinary Medicine; K.A. Dawson, University College Dublin / Centre for
BioNano Interactions; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

Engineered nanoparticles (NPs), given the multitude of uses, can be released in aquatic environments, both intentionally and accidentally. To date there is no shortage of studies concerning the environmental fate and ecotoxicity of widely used NPs, such as titanium and silver oxides. However, much less is known about NPs employed in novel cutting-edge applications as nanomedicine. For this purpose, we studied five biomedical NPs, namely polyethylene glycol (PSNH), europium doped-cerium oxide (CeO₂@Eu), carbon dot-doped silica (SiC@B), and polyelectrolyte-glycol-functionalized silica (SiO₂-B and SiO₂-PEG, respectively), and we assessed their behaviour and ecological impacts in natural river- (NRW) and seawater (NSW). Hydrodynamic sizes were monitored for 30 days by dynamic light scattering (DLS) and showed remarkable differences in NRW compared to NSW of both bare and PEGylated SiO₂ NPs. In fact, SiO₂ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PSNH, CeO₂@Eu and SiC NPs did not show such a clear distinction between the two natural media, reaching micrometric sizes after 24 h. In order to address sedimentation phenomena, normalized derived count rates (DCR) were used to estimate the sedimented fraction of suspended NPs in the both media. SiO₂-B and SiO₂-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected from suspensions after 24 h. On the contrary, no such difference was observed for PSNH, CeO₂@Eu and SiC NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrophotometric assays. SiO₂-based NPs bioaccumulation studies were examined in two natural media, which underwent disintegration processes in both media. Flow-field-flow-fractionation (Flow-FFF) coupled to ICP-QQQ-MS (for the silver nanoform) and ICP-MS (for the silver nanoform) was used to evaluate the contribution of particulate silver to the alga, Pseudokirchneriella subcapitata (OECD Test Guideline No. 201). Long-term toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoform was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, conventional dissolved silver (0.45 μm membrane filtered) and colloidal dissolved silver (3 keV centrifugation filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 μm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow-Fractionation (4F) coupled to ICP-MS (for the silver nanoform only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rate of silver nanoparticles (PSNH) in two natural media, performed using freshwater and marine microalgae (OECD, 1994). PSNH and CeO₂@Eu were toxic in the OECD synthetic freshwater media only, while the remaining NP types did not show any sign of toxicity. A significant p < 0.05 effect emerged for PSNH in OECD synthesized media, while other observed repeated tests in NRW, while again no toxicity was confirmed in NSW. Altogether, our results provide a realistic insight in the fate and toxicity of diverse NPs, also highlighting the importance of testing complex natural matrices for a more realistic risk assessment.

MO409

Development of a method for the analysis of nanoparticles in the freshwater clam Corbicula fluminea


As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify read-across from ionic silver to silver nanofroms. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanofrom with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken comparing the effects of this silver nanofrom with silver nitrate using the following internationally accepted standards: Toxicity to the alga, Pseudokirchneriella subcapitata (OECD Test Guideline No. 201). Long-term toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoform was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, conventional dissolved silver (0.45 μm membrane filtered) and colloidal dissolved silver (3 keV centrifugation filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 μm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow-Fractionation (4F) coupled to ICP-MS (for the silver nanoform only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rate of silver nanoparticles (PSNH) in two natural media, performed using freshwater and marine microalgae (OECD, 1994). PSNH and CeO₂@Eu were toxic in the OECD synthetic freshwater media only, while the remaining NP types did not show any sign of toxicity. A significant p < 0.05 effect emerged for PSNH in OECD synthesized media, while other observed repeated tests in NRW, while again no toxicity was confirmed in NSW. Altogether, our results provide a realistic insight in the fate and toxicity of diverse NPs, also highlighting the importance of testing complex natural matrices for a more realistic risk assessment.

MO411

Investigations on the uptake pathway and accumulation of silver from manufactured silver nanoparticles in the freshwater amphipod Hyalella azteca

S. Kühn, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / BioNano Interactions and Animal Metabolism; B. Meisterjahn, Fraunhofer IME / Microstructure of Materials and Systems IMWS / Business Unit Biological and Macromolecular Materials; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism

Testing nanoparticles (NMs) under environmentally relevant conditions is an important aspect regarding the risk assessment of nanomaterials that enter the water cycle. For that reason, the present project contributes to the understanding of the different pathways for NMs into the aquatic environment we developed a coupled test system using the effluents of model STPs in a chronic exposure test with the epibenthic amphipod Hyalella azteca, which is commonly used for ecotoxicity studies. Previous studies with this test system showed that silver (Ag) from silver NMs is accumulated by H. azteca exposed to model STP effluents. However, the pathway of Ag accumulation, i.e. ingestion of particulate Ag and/or bioaccumulation of dissolved ionic silver, is still unknown. To further elucidate the uptake pathway of silver from model STP effluent, two groups of H. azteca with five animals each were placed in a single test vessel. The two groups were separated by a stainless-steel strainer. One group was fed contaminated sludge from model STPs, loaded on glass fibre filters. The second group, located in the stainless-steel strainer, was fed uncontaminated control STP sludge had no direct contact to the test vessel and the test water contained Ag NMs. The study was carried out with five replicated test vials with two groups of amphibods each. Water samples were taken within the strainers to measure the silver content in the media and to prove that the animals fed control sludge were not in contact with Ag NMs potentially released from the contaminated sludge. After an exposure period of 7 (21) days Ag content of the water and animal samples collected at the end of the exposure period was measured by ICP-MS or ICP-OES to determine the accumulation of Ag in both groups. The presence of NMs in the animals was examined by high-resolution transmission electron microscopy (TEM) and methods of correlative microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved ionic Ag to the accumulation of Ag from STP effluent.

MO412

Ecotoxicity of silica and silver nanoparticles (ENPs) on hyporheic copepods as a function of their bioavailability by dissolved organic matter (DOM) and water hardness of environmental samples

M. Marzo, CONICET, M. Saenz, PRIET CONICET, National University of Luján; D. Galassi, Universita dellAquila; J. Alberdi, National University of Luján; T. Di Lorenzo, Institute of Ecosystem Study CNR

The development and production of engineered nanoparticles has increased the potential for interactions of these nanomaterials with aquatic and terrestrial environments. ENPs are one of the commonly used particles in nanotechnology-based products. They are used in a wide spread application such as chemical industry, cosmetics, medicine and agriculture. The ENPs predicted concentrations using market study production estimates based on life cycle release models and measurements, in biosolids, was 5 - 123 and 0.02 – 2.01 mg/kg and, in
liquid effluents 0.03 - 6.74 and 0.003 – 0.26 g/L, for Si and Ag NPs respectively. Environmental exposure models have shown that soils and sediments can provide important reservoirs of these nanomaterials, especially in the presence of high concentrations of DOM. These such as the humic substances found in water, sediment, and soil, are ones of the substances capable of interacting with ENPs. To understand and assess the effects of NPs on the environment, should be well established quantitatively the concentration–response relationships. Also, to know how NPs can be transformed and regulate their toxicity. Designed studies are therefore required in order to understand the fate, transport, stability, and toxicity of nanoparticles. By the other hand, there are many studies about the effect of ENPs on hyporheic copepod species and less related with DOM concentrations. The hyporheic zone is a region underneath streamed that integrates surface and groundwater. Its location is central to biogeochemical linkages between the riparian zone, dissolved nutrients, and benthic biota. Even if in this DOM sources are relatively constant, biogeochemical processing within the hyporheic zone resulted a DOM pool that is temporarily dynamic regarding its composition and concentration. In this study we evaluated how DOM concentrations and water hardness are related with the acute ecotoxicity of Si and Ag NPs on the survival of Metanauplii. Polydispersed TiO2 particles are widespread hyporheic species. Toxicity of AgNPs was related with DOM concentrations and showed a non-significant Beta for water hardness. On the contrary, for SiNPs, DOM and water hardness quantitative relationships were negatively correlated with ecotoxicity on this freshwater invertebrate.

MO413 Long-term exposure of ZnO nanoparticles to freshwater microalgae cultivated in batch and semi-continuous mode A.F. Aravanitidis, F. Andreou, I. Manarioti, University of Patras / Civil Engineering Nanoparticles (NPs) have always existed in the physical environment. The rapid development of commercial applications involving the use of a large variety of synthetic nanoparticles has resulted in the introduction of higher amounts of nanoparticles in the environment. As the use of NPs increases, their effect to the coastal food chain and ecosystems is crucial. The aim of this work was to investigate the toxic effect of zinc oxide (ZnO) NPs on freshwater microalgae in batch and semi-continuous feeding mode for longer period than the time used in typical toxicity tests. Scenedesmus rubescens was selected as model microorganism since it is a common freshwater microalgae. S. rubescens exposed to ZnO NPs concentrations varying from 0.081 to 810 mg/L for 28 days in batch mode conditions, while in semi-continuous mode it was exposed to 0.081mg/L of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effects of the NPs were investigated in terms of growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of S. rubescens was greater in the presence of ZnO NPs, and the lipid content was higher.

MO414 Effects of sunscreen-derived TiO2 nanoparticles on freshwater and marine organisms s. schiavo, ENEA CR; M. Oliviero, University Parthenopeo; A. Philippe, Universität Koblenz-Landau / Institute for Environmental Sciences Group of Environmental and Soil Chemistry; s. manzo, ENEA / SSPT-PROTER-BES Sunscreens represent one of the main source of engineeredTiO2 nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare model TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of TNPs extracted from three different commercial sunscreens upon freshwater and marine organisms: microalgae, (Pseudokirchneriella subcapitata; Dunaliella tertiolecta) and crustaceans, (Euphausia superba). Microalgae are suitable indicators for growth rate, nutrient removal and lipid production. The toxic effect of TiO2 NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of TiO2 NPs and were more resistant. In the semi-continuous mode the growth of S. rubescens was greater in the presence of ZnO NPs, and the lipid content was higher.

Silver nanoparticles affect the early development of Tisbe battagliai: pristine vs aged particles A. Geogheganpoivan, Norwegian Institute for Water Research NIV K. J. Forkas, SINTEF Ocean / Environmental Technology; K. Landau / Institute of Biology; P. A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology; A. Macken, NIVA / marine pollution Silver and titanium nanoparticles are used in numerous consumer products and applications and they are likely to enter wastewater streams, reach wastewater treatment plants and aquatic systems through wastewater and effluent discharge. Nanomaterials undergo transformation in different matrices altering their fate, behaviour, bioavailability and toxic potential that could differ greatly from the pristine counterparts. There are challenges on the detection and quantification of nanomaterials at environmentally relevant concentrations in complex media and matrices such as whole organisms. Moreover, studies on uptake and effects of transformed particles on marine species is largely lacking. The aim of the present study is to better understand the transformation of Ag and TiO2 NPs in wastewater and assess the uptake, bioaccumulation and subsequent developmental effects of pristine and transformed particles on the marine organism Tisbe battagliai. In this study the harpacticoid copepod Tisbe battagliai was selected as a relevant marine species and the effects on the nauplar development was assessed over an exposure period of 6 days. The mortality and the developmental stage of the organisms was assessed daily. Initial investigations focus on the study of Ag (before coated in 5 nm, nanoComposix) and TiO2 particles (nominal primary size of 5 nm, NM-101, JRC) and their mixture. Moreover, the particles were aged in synthetic wastewater (for 4 hours under stirring conditions) and the effects of “aged” particles on the uptake, bioaccumulation and nauplar development was assessed. Extensive characterization of the particles in synthetic wastewater, seawater and exposure media was performed with dynamic light scattering (DLS), ultraviolette–visible spectroscopy (UV-VIS), single particle-Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM). Moreover, nanoparticle uptake, bioaccumulation and intracellular localisation is evaluated with TEM and sp-ICP-MS. Results showed that the both particles types were stable in seawater and biological matrices. In contrast, particle concentrations decreased over time in seawater, which was likely due to both dissolution and aggregation for Ag, and aggregation in TiO2. TiO2 particles were found to be more stable in seawater after the aging process, which can affect their impacts on exposed organisms.

Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanopolare and silver chloride M. Vannuci-Silva, UNICAMP / Institute of Biology; S. Cadore, University of Campinas; G. Umbuzeiro, School of Technology, UNICAMP / LAEG The relatively recent development of engineered Ag nanoparticles has expanded considerably. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like Parhyale haawaiensis, are deposit-feeding species ecologically relevant, becoming an excellent model for ecotoxicology studies. In addition to the traditional toxicity studies, internal doses determination, for example in the haemolymph, can provide information on the level of exposure to toxic metals. The aim of this study was to investigate Ag concentration in the haemolymph of the marine amphipod Parhyale haawaiensis exposed to food containing AgNP and AgCl. We hypothesized the actual AgNP could be absorbed by the gut leading to a higher amount of Ag in the haemolymph when compared to food containing AgCl. Silver nanoparticles < 100nm (Sigma Aldrich) or elemental Ag (from AgCl, Sigma Aldrich) were incorporated in a marine fish diet. Fish were exposed to 0.04 and 0.1 mg L-1 of approximately 200 mg kg-1 P. haawaiensis organisms (8 months) were placed individually into a plastic container (100 mL of reconstituted saline water) and fed on alternate days with control, AgNP, or AgCl amended feed pellets. After 1 hour of feeding, each organism was washed and placed into a new plastic container with clean salt water to ensure that the exposure was only via food. The amphipods were reexposed during 7, 14 and 28 days. After exposure, the haemolymph was collected using a thin glass capillary, weighted and analysed. Three pooled samples of 4 organisms (2 females and 2 males) were tested per exposure concentration. The silver determination in haemolymph was carried out by a Graphite Furnace Atomic Absorption Spectrometer (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feed, reaching 8.4±0.7 mg g-1 in comparison to 3.7±1.0 mg g-1 for AgCl. At the longest exposure time, the increase of silver concentration was related to the exposure duration. Therefore, it appeared that ingested silver is more bioavailable to P. haawaiensis as AgNP than when it is its salt form. Data strongly suggest that nanoparticles were uptaken by the gut and distributed in the
haemolymph causing this increase in Ag content. More studies are required to verify the Ag form present in the haemolymph and how it will induce damage in the exposed organisms.

MO417 Toxic effects of multi-walled carbon nanotubes on bivalve molluscs Titania Nanoparticles on human bronchial cells

L. De Marchi, University of Aveiro, Department of Biology & CESAM / Departamento de Biologia & CESAM; V. Neto, Department of Mechanical Engineering & Centre for Mechanical Technology and Automation (TEMA), University of Aveiro 3810-193, Portugal; C. Pretti, Department of Veterinary Sciences, University of Pisa, San Piero a Grado; E. Figueira, University of Aveiro / Biological and Environmental Sciences Department (CENIMAR); M.A. Soares, University of Aveiro / department of Biology & CESAM; F. Chielli, University of Pisa, UdR INSTM Pisa; Pisa 56126; A.M. Soares, University of Aveiro / department of Biology & CESAM; R. Freitas, University of Aveiro / Departamento de Biologia CESAM

The use of carbon nanomaterials (CNMs) has increased rapidly in the last years, mainly due to their important properties such as electromagnetic, optical, catalytic, mechanical, thermal, and pharmacokinetics. Currently, carbon nanotubes (CNTs) are one of the most important and commercially used CNMs. CNTs are hollow graphene cylinders that are microns to millimeters in length and can be divided in single-walled (SWCNTs) with a diameter of 0.7 to 3 nm, and multi-walled (MWCNTs) with a diameter of 10 to 25 nm. CNTs are engineered with a wide variety of core structures and surface functionalities that change their chemical and physical properties to enhance their suitability for different industrial applications. However, despite of the large array of available CNT configurations, their impacts on aquatic organisms, especially on invertebrate species, are still limitedly known. To our knowledge, no information is available on how surface chemistry alteration (functionalization) of CNTs may impact the toxicity of these CNMs. In this study, we investigated the functionalization of SWCNTs with several functional groups (PEG, diacetylene, propionic acid, phosphoric acid, etc.) to alter their surfaces and verify potential differences in their toxicity. We confirmed exposure (28 days) to unfunctionalized MWCNTs (Ni-MWCNTs) in comparison with functionalized MWCNTs (f-MWCNTs), by introducing polar groups such as carbonyl groups (-COOH) in order to achieve better dispersibility in water, were evaluated in the Manila clams Ruditapes philippinarum, one of the most dominant bivalve of the estuarine and coastal lagoon environments. Alternations induced in clams’ oxidative status, neurotoxicity and metabolic capacity were performed. The results obtained clearly showing that both Ni-MWCNTs and f-MWCNTs were able to generate oxidative stress in the exposed clams and were also responsible for changes in organisms’ metabolism (expressed in alteration of energy reserves) and neurotoxicity induction in R. philippinarum, however greater impacts were caused by f-MWCNTs. Both strategies did not produce alterations in the aggregation behavior of the clams. The exposure of clams to functionalized surface-modified MWCNTs induced slight DNA damage, statistically significant at 100 µg/ml, and induction of cytokine induction, probably due to its smaller size, higher agglomeration tendency and capacity to induce ROS. This study is partially financed by FP7-NANoREG project, Grant n. 310584.

MO419 Transformations of engineered nanomaterials during wastewater treatment: the role of engineered surface coatings and the impact on environmental fate

M. Surette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical and Environmental Engineering; R. Kaege, Eawag - Swiss Federal Institute of Aquatic Science and Technology (Eawag)

Previous research has highlighted the importance of particle-particle interactions in controlling the environmental fate of engineered nanomaterials (ENMs). Yet our ability to accurately predict the outcome of these interactions within environmental systems is still limited. One obstacle is the inherent complexity of these interactions which depend on several factors, including the properties of the ENM. However, the properties of the ENM are dynamic and can be altered via myriad transformation processes (e.g., over-coating via natural macromolecules, surface coating displacement, etc.). When considering the pathways by which ENMs may be released to the environment, wastewater treatment plants (WWTPs) not only act as gateways controlling the release of ENMs but they may also serve as reactors adjusting the properties of the ENMs. Therefore, to improve our understanding of ENM interactions within environmental systems we must first understand the extent to which ENM properties are altered within WWTPs. ‘In the objective of this research is to develop a protocol that simulates the transformations or ‘aging’ ENMs experienced within a WWTP. The initial focus is on the effect of the dissolved components within the wastewater medium and whether ENMs with initially dissimilar properties will have similar properties after aging. To accomplish this, 12 model ENMs were aged in WWTP influent and treated effluent (TE) or control (C). We aged two different types of nanomaterials: single-walled carbon nanotubes (SWNTs) and metallic silver nanoparticles (AgNPs) with different engineered surface coatings were selected as model ENMs. A series of batch reactors, each containing a sample from a different stage in a WWTP, were used to assess the impact of each stage on the ENMs. Each wastewater sample was first filtered to remove suspended solids and then dosed with a single type of model ENMs. Each reactor was mixed and aliquots were collected over time. The aliquots were then analyzed by a variety of techniques to investigate the effect of the media on the properties of the ENMs, including size, surface charge, stability/aggregate structure, and hydrophobicity. In Future research will investigate the impact of the suspended solids and the overall effect of the transformations on the aggregation behavior of the ENMs upon their introduction to different environmental mediums (e.g., surface water). In simulating the discharge of the aged ENMs to the aquatic environment through waste water treatment and terrestrial pathways during material production, use and disposal. Whist freshwater sediments have been identified as an ecological compartment at risk of contamination, very little is known about the fate of ENMs entering these sediments. We present a simple separation method to isolate the colloidal (< 200 nm) and dissolved (> 1kDa) fractions of the sediment pore water, which can be run alongside biological exposures. This provides the context for how these biologically accessible fractions of ENMs in the sediments may relate to intrinsic particle properties such as size, core composition and coatings. Using cerium oxide (CeO₂NP) and silver nanoparticles (AgNPs) routes of entry into the aquatic environment through these sediments in the freshwater sediment dwelling worm Lumbriculus variegatus. By following the fate of these particles in the solid bound, colloidal and dissolved fractions of the sediment, we provide context to explain differences in both the route and extent of uptake of these materials by the worm. This poster presents the successful application of this method to investigate the implications different routes of entry into the aquatic environment through these sediments in the freshwater sediment dwelling worm Lumbriculus variegatus.

MO420 Freshwater sediments as an environmental reactor: defining biologically relevant fate parameters to provide context for nanomaterial bioaccumulation

R. Cross, University of Exeter; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; T.S. Galloway, University of Exeter / Biosciences

As the field of nanotoxicology matures there is a call for the research focus to progress from hazard identification to more ecologically relevant assessment of the risk that engineered nanomaterials (ENM) pose as they undergo a range of transformations in the environment. This will require test designs prioritising environments most at risk of contamination, and which not only measure ecologically relevant endpoints, but also characterise the fate, transformations and behaviours of particles within the test system, providing the context for differences observed between treatments. Freshwater sediments present an ecosystem in need of further research, as these are predicted to be major sinks of ENMs entering the aquatic environment though waste water treatment and terrestrial pathways during material production, use and disposal. Whist freshwater sediments have been identified as an ecological compartment at risk of contamination, very little is known about the fate of ENMs entering these sediments. We present a simple separation method to isolate the colloidal (< 200 nm) and dissolved (> 1kDa) fractions of the sediment pore water, which can be run alongside biological exposures. This provides the context for how these biologically accessible fractions of ENMs in the sediments may relate to intrinsic particle properties such as size, core composition and coatings. Using cerium oxide (CeO₂NP) and silver nanoparticles (AgNPs) routes of entry into the aquatic environment through these sediments in the freshwater sediment dwelling worm Lumbriculus variegatus. By following the fate of these particles in the solid bound, colloidal and dissolved fractions of the sediment, we provide context to explain differences in both the route and extent of uptake of these materials by the worm. This poster presents the successful application of this method to investigate the implications different routes of entry into the aquatic environment through these sediments in the freshwater sediment dwelling worm Lumbriculus variegatus.
the sediment and lack of dissolution (< 1% of spiked cerium was extractable with water). Transdermal uptake of AgNP was attributed to dissolved silver in the pore waters and uptake of soluble silver, potentially through localised dissolution of particles at the worms’ surface.

**MO421**

**Examining the role of TiO2 nanoparticle surface transformations on transport and toxicity**

A.R. Deline, Oregon State University / Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering

Titanium dioxide nanoparticles (TiO2 NPs) have great potential for use in a variety of commercial and environmental applications, including the photocatalytic treatment of contaminants. While processes like microbial inactivation and the generation of reactive oxygen species (ROS) have been studied under a variety of irradiation and water chemistry conditions, there exists limited mechanistic insight as to how these processes are related to the molecular-level surface transformations that may occur under different environmental conditions. This study is using surface-sensitive characterization techniques, including x-ray photoelectron spectroscopy (XPS), to examine the impact of UV irradiation, temperature, and water chemistry exposures on the metal oxide surfaces of both pure anatase and mixed anatase-rutile TiO2 NPs. Initial XPS studies of the impact of simulated solar irradiation revealed that solar irradiation resulted in a decrease in the aliphatic carbon present on the TiO2 surface and an increase in the oxygen-bonded carbon, with no observable effect on the oxidative properties of the metal oxide. Additional studies will be presented that are surface-chalcophile elements. To the best of our knowledge, our solar irradiation studies may represent a novel approach to modulating the Fresnel lens to increase the irradiation intensity and solution temperature. The relationships between these molecular-level surface properties and the extrinsic properties of the TiO2 NPs are being further explored using a suite of functional assays. Assays that have been optimized for the characterization of TiO2 NPs in this study include methylene blue dye degradation (photocatalytic activity), rose bengal dye photobleaching (activity), and fluorescein dye conversion (ROS generation). Ultimately, changes in the properties of the TiO2 NPs will be compared to larger scale environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

**MO422**

**Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles**

A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering, Particle Lab; A. Voegelin, R. Kaegi, Eawag - Swiss federal Institute of Aquatic Science and Technology

Organic substances from sewage and engineered nanomaterials (ENM) will inevitably come into contact with different types of dissolved organic matter (DOM). It has been shown in a large number of studies that DOM influences the colloidal properties of ENM, which in turn impact subsequent transport and transformation processes. Sulfidation, as an important environmental transformation process, has significant implications for the fate and the ecological effects of ENM. In this study, we hypothesized that both the DOM chemical composition and the DOM concentration may influence the sulfidation rate of CuO NPs. We investigated the role of the DOM composition on the sulfidation rate of CuO NPs under simulated sewage and wastewater conditions. The sulfidation reaction involved the reaction of the CuO nanoparticles with hydrogen sulfide (H2S) and the resulting sulfide concentration was measured using X-ray absorption spectroscopy (XAS). The results indicated that the sulfidation rate of CuO NPs is influenced by the DOM composition, with higher sulfidation rates observed at higher DOM concentrations. The sulfidation reaction was found to be a first-order process with respect to the concentration of H2S. The results of this study highlight the importance of understanding the interactions between ENM and DOM in aquatic environments, and the potential implications for the fate and ecological effects of ENM.

**MO423**

**Evaluating spICP-TOF-MS for Exploring Environmental Nano-scale Processes**

M.D. Montaño, University of Vienna / Environmental Geosciences; B. Gerstmann, A. Laycock, N. Tepe, T. Hofmann, F. von der Kammer, University of Vienna / Department of Environmental Geosciences

The advent of single particle ICP-MS (spICP-MS) has helped advance the field of nanometrology, specifically at concentrations and in matrices that are environmentally relevant. However, the concentration of naturally occurring nanoparticles (NPs) and nanominerals far outweigh the expected released concentrations of engineered nanoparticles (ENPs), making their detection by single element spICP-MS and their subsequent risk assessment a challenge. The interaction of ICP-time-of-flight mass spectrometry (ICP-TOF-MS) with single particle impacts may overcome these challenges, as elements are detected quasi-simultaneously at dwell times of 46µsec, covering nearly the entire atomic mass range (7-250 m/z). By examining differences in the chemical composition on a particle-by-particle basis, NNPs and ENPs can be differentiated, and geochemical processes occurring at the nano-scale can be explored on an individual particle basis. In order to establish this technique, we have developed and tested several functional assays, analyses, several multi-element and multi-isotope nanoparticles were analyzed using traditional spICP-MS (with quadrupole mass filtering) and with spICP-TOF-MS. The precision and accuracy for particle sizing and counting were evaluated for each technique for a range of elements to explore the advantages and potential limitations of these techniques as they apply to environmentally and geochemically relevant systems. To illustrate the advances made in multi-element monitoring by time-of-flight, single particle analyses were performed on both a quadrupole ICP-MS and an ICP-TOF-MS, and using 3ms and 100µs dwell times on both instruments. Particles analyzed consisted of mixtures of well-defined AuAg core-shell NPs with Au and Ag only NPs, polydisperse ceramic NPs with well-defined chemical compositions, and environmentally relevant colloidal suspensions containing ENPs. These systems were analyzed by spICP-MS and spICP-TOFMS to examine the geochemical realm on an individual particle basis. The further development of this technique may also lead to a better assessment of ENP exposure in test systems and nature, improving on environmental risk assessment and gaining a better understanding of ENP interactions with naturally occurring colloids.

**MO424**

**Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy**

D.L. Windell, University of Exeter / College of Life and Environmental Sciences; J. Moger, The University of Exeter / College of Engineering, Mathematics and Physical Sciences; M.J. Winter, The University of Exeter / College of Life and Environmental Sciences; S. Owen, AstraZeneca / Safety Health Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

Nanotechnology applications have increased dramatically in recent years including in the pharmaceutical sector. The unique properties of nanoparticles have been exploited in medicine in both drug development and drug delivery. Their small size and capability for manipulation and functionalisation allows for great improvements in drug efficacy. Nanomedicines can cross a wide range of biological membranes and barriers (including the blood brain barrier) facilitating the diagnosis and treatment of life threatening diseases such as cancer. Although nanotechnology may help to reduce the toxicity and side effects of drugs, the actual carriers themselves may also have the potential for inducing toxic effects, depending on their composition. This raises the need for safety evaluations of these drug delivery systems both in patients, but also with respect to their potential for environmental impact. Very little is known regarding the potential impacts associated with the release of these nanodrugs or their carrier systems into the environment, although some studies have begun to investigate the potential toxic effects of various nanoparticle shapes and coatings in aquatic organisms. Using various sizes of gold nanoparticles (between 10 and 100nm in diameter) with a non-reactive methyl polymer and fluorophore coating, we have traced their uptake and tissue partitioning using a casper mutant zebrafish and light sheet microscopy. We have constructed a light sheet system based on the OpenSPIM platform, (SPIM - Selective Plane-illumination Microscopy) which allows us to create 3D images and 4D videos in real-time. Using this rapid image acquisition technique we showed a size selective uptake of the nanoparticles into the kidney and minimal uptake in other organs. Depuration studies indicate a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebrafish transgenic lines for oxidative stress and kidney function. We are now investigating the effect different coatings and functionalisations have on the uptake and distribution of gold nanoparticles in the larval zebrafish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

**MO425**

**SETAC Nanotechnology Interest Group**

C. Svendsen, CEH, Wallingford / Pollution and Ecotoxicology

*Hydrophobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (P)*

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SETAC Europe 28th Annual Meeting Abstract Book
MO426
Effect of ageing on poly cyclic aromatic hydrocarbon composition of biochar
G. Siegmund, Technische Universität München / Chair of Analytical Chemistry and Water Chemistry; T. Bucheli, Agroscope ART / Environmental Analytics; I. Hilber, Agroscope / Environmental Analytics; T. Hüffer, M. Kah, T. Hofmann, University of Vienna / Department of Environmental Geosciences
The influence of ageing on biochar properties has been investigated by comparing three standard biochars, from digestate (BC), sewage sludge (BC), and sewage sludge from anaerobic digestion (BC). Biochar bulk properties showed only minor changes following both artificial and field ageing, indicating high biochar stability. Concentrations of the 16 US EPA PAHs were measured in all of the biochars and a contaminant trap was used to investigate the effect of ageing on their bioaccessibility. The concentrations of total and bioaccessible PAHs ranged from 4.4 to 22.6 mg/kg and 0.0 to 9.7 mg/kg, respectively. Concentrations of the 16 US EPA PAHs decreased following field ageing, but the proportion of low molecular weight PAHs increased. The observed changes in PAH composition with field ageing can partially be explained by uptake from the surrounding soil. In addition, size discriminatory intra-biochar transfer processes also contributed to the changes in PAH composition. To better understand changes in PAH composition with ageing, an additional broad range of alkylated PAHs was also analyzed in selected samples. Our results show that the tested artificial ageing protocols are unable to approximate the changes in PAH composition resulting from field ageing. Nevertheless, total and bioaccessible PAH concentrations decreased for both artificially and field-aged biochars, indicating the potential for PAH reduction of PAs when they are freshly produced and that the risk of PAH release decreases with ageing. Therefore, well-produced biochars that meet European Biochar Certificate (EBC) and International Biochar Initiative (IBI) quality thresholds for total PAH concentrations are unlikely to present a risk with regard to PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

MO427
Field testing of a new calibration approach for silicone passive samplers: Comparison of the concentration ratio method using samplers of different thicknesses with the PRC approach
H. Fuchte, Institut für Umweltforschung / Institute for Environmental Research BioV; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; K. Smith, RWTH Aachen University / Institute for Environmental Research
Silicone passive sampling is a common method for sampling bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often silicone samples are to be used to kinetic mode and sampler calibration is unavoidable. Most commonly, exchange kinetics are derived from the release rates of performance reference compounds (PRCs) spiked into the sampler prior to usage. Unfortunately, PRCs can be expensive and are not always available for all compounds. Due to these challenges, a complementary calibration approach using passive samplers of different thicknesses has been developed and investigated in labs and the field. This study describes the testing of the approach in situ in the field. The sampling location was a storm water retention pond collecting storm water run-off from a motorway. The pond has two basins, one of which is equipped with a Floating Treatment Wetland (FTW) for cleaning the run-off. Two sets of duplicate samplers with 3 different thicknesses were installed in the inflow, after the FTW and in the reference basin without a FTW. One set of samplers was taken out after the first and the second after five weeks. These were extracted and analyzed for PAHs, with the concentration ratios for the different thicknesses used to calculate the field dissolved concentrations. All samplers had been additionally loaded with PRCs, with the decreases also used to calculate the field levels. These were compared to the results from the concentration ratio approach, underlining its suitability as a complementary calibration method and its application domain.

MO428
Use of biochar for hexachlorocyclohexane sorption: a mechanistic approach
L. Silvan, g. cornelissen, s.e. hale, Norwegian Geotechnical Institute
Hexachlorocyclohexanes (HCHs) are halogenated compounds composed of 4 main isomers: α-HCH, β-HCH, γ-HCH, and δ-HCH, which differ for their tridimensional structure. Commercial HCH in technical grade is a mixture of these isomers. HCH has been extensively used as a pesticide despite the fact that only γ-HCH (lindane) has insecticide properties. HCHs’ toxic, carcinogenic, teratogenic and neurotoxic effects have been reported in humans; and the HCHs have a clear tendency to accumulate in the environment. For these reasons, HCHs are contaminants of worldwide concern and have been extensively removed from the environment. Various remediation techniques have been used to remove HCHs in aqueous solution, among these, adsorption is the most common used one. Biochar (BC) is a carbonaceous material that is a promising sorbent amendment material due to its high adsorption of organic and inorganic contaminants, and to its low cost. In this study three standard biochars, from digestate (BCd), from greenhouse tomato waste (BCgw) and from durian shell (BCsh), have been used as sorbent materials for the HCHs removal from water. The BCs used cover a wide range of surface area (5.4 - 328.6 m² g⁻¹), pore volume (5.1 - 186.6 cm³ g⁻¹), pore dimension (1.05 - 5.85 Å), pyrolysis temperature (400 – 700 °C) and surface properties (including iron content). Batch isotherm tests were carried out in deionized water with the single isomers and the mixture of α-, β-, γ- and δ-HCH. The HCH concentration was ranged between 1 and 500 µg L⁻¹ in the monocomponent isomers and between 5 and 2000 µg L⁻¹ (total concentration) in the mixture isomers. Polyethylene (PE, 26 ± 0.02 cm² g⁻¹) was used as a passive sampler, before assessing the HCHs concentrations in water. The sorption performances of the biochars is related to their physicochemical properties. Preliminary results have shown the adsorption performances are correlated with the BC surface area and iron content, where a higher adsorption is observed as surface area and iron content increase. Clear differences in the behavior of the isomers were observed.

MO429
Development of a Method for Measurement Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers
M. Reininghaus, RWTH Aachen / Bioigien; T. Parkerton, ExxonMobil Biomedical Sciences Inc. / Toxiology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Engineering
Frequently, the total PAH sediment concentration reported for a sample has been based on 16 individual priority pollutants according to the U.S. EPA Method 8310. For pyrogenic sources of PAHs (e.g. incomplete burning processes), the parent PAHs are the predominant species. In contrast, PAHs from petrogenic sources (e.g. crude oil) are dominated by alkyl PAHs. Therefore, the U.S. EPA narcosis model for PAHs is not applicable for petrogenic biochars. Our approach is based on the calculation of PAH toxic units (TU) by comparing the concentra

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Delle Site, A. Factors affecting sorption of organic compounds in natural
indicating an overestimation of the risk, if only total initial concentrations in soils as more polar PACs composed of soils. The leachable fraction was generally greater for more hydrophilic PACs, such as those containing two or three rings. The first approach uses passive dosing from a saturated silicone droplet formation. The first approach uses passive dosing from a saturated silicone

MO431 PAHs in water and surface sediments from Douro River estuary and Porto Atlantic coast (Iberian Peninsula, North Portugal) — Risks for biota and human health? M. João Rocha, ICBAS – U.Porto, CIMAR, CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruzeiro, CIMAR / CIMAR LA; Porto, CEF / FCTUC; U.Coimbra; R. Rocha, ICBAS – U.Porto, CIMAR, CIMAR LA The 16 PAHs were determined in 16 pristine sites (PAHs) in surface waters from the Douro River estuary and nearby Atlantic seacoast. These areas bath Porto and Gaia cities, widely known by the production/export of the famous Porto wine. This area, besides being highly industrialized, also holds an oil refinery, an important harbour, intense maritime traffic, and recreational marinas. For this study, water samples were taken from four strategic sampling sites, at six different times of the year. These samples were extracted by ultrasound technique (suspended fraction) and solid-phase extraction (dissolved fraction), before their quantitative analysis by gas chromatography–mass spectrometry (GC-MS). Data showed the presence of all analysed PAHs in all samples, which global amounts (Σ16PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≈ 52 μg/dot of potential taxon-specific effects. However, the RAAF for UVCBs is still under development due to their added complexity. One recommendation of the RAAF when applying a category approach is to present data in a matrix to demonstrate that properties are similar or follow a regular pattern. In this presentation a category data matrix will be presented for the Concawe category of vacuum hydrocracked gas oils (VHGO). Available historical experimental aquatic toxicity data will be presented alongside substance identity information, predicted EL50 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (BE–SPME) screening studies. The latter is a technique which measures bioavailable hydrocarbons, and has been demonstrated to correlate well with experimental and predicted aquatic toxicity data. The resulting, complimentary dataset forms a wealth of evidence upon which to justify category approaches to the read-across of experimental toxicity data.

MO433 Occurrence and availability of PACs and total AhR agonists in contaminated soils - Combining in vitro reporter gene assay and chemical analysis with passive sampling and column leaching M. Larsson, Orebro University / Man-Technology-Environment research centre (MTM); M. Lam, RWTH University Aachen; P. van Hees, Orebro University / MTM Research Center; J. Giesen, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and People's Food Centre, M. Kingwall, Orebro University / Man-Technology-Environment research centre (MTM) Polycyclic aromatic hydrocarbons (PAHs) are common contaminants at industrial sites, and occur as complex mixtures of thousands of PAHs and heterocyclic compounds (NSO-PACs) among others, collectively referred to as polycyclic aromatic compounds (PACs). The contaminant composition differ widely due to contaminating source strength, settling pattern and the high complexity in PAC-contaminated areas, current risk assessment of PACs is commonly based on chemical analysis of the 16 US EPA PAHs. Consequently, many PACs are unknown. There is an urgent need of improved and applicable analytical methods to assess environmental levels and fate of potential toxic PACs to evaluate risk to human health and the environment. An important concern regarding sites contaminated with PACs is the risk of groundwater contamination by release of the compounds from soils. The aim of this study was to investigate the occurrence of 77 PACs including PAHs, alkyl-PAHs, oxy-PAHs and NSO-PACs among total aryl hydrocarbon receptor (AhR)-agonists in soils from historical contaminated sites and to assess the availability of the compounds in the soils. A new approach combining chemical (GC/MS) and biological measurements (H4IIE-luc) combined with characterization of availability by use of a column leaching test and passive sampling was used. This approach allowed screening of potentially toxic metabolites of PACs in soils during remediation. The results show that chemical analysis of 16 US EPA PAHs to determine the degree of contamination of PACs in soils greatly overlooks toxicologically relevant PACs. Agonists in concentration of submicromolar concentrations were captured highly efficiently than their corresponding PACs in all soils, indicating low availability of the compounds in soils. The leachable fraction was generally greater for more hydrophilic PACs, such as more polar PACs composed of two or three rings. Contribution of the analyzed PACs to the overall AhR-mediated activities detected in soils, leachates and passive samplers was pretty small and confirms presence of several other AhR agonists in soils. Only a small fraction of AhR agonists were available in soils, indicating an overestimation of the risk, if only total initial concentrations in soils would be considered in risk assessment. However, the results show that analysis of available fractions based on only 16 US EPA PAHs have the potential to underestimate the risk of the soils.

MO434 Verification of read-across for aquatic hazard properties of Petroleum Substances in REACH registrations Y. Verhaegen, CONCAWE; C. Hughes, Shell Health / Risk Science Team; C. Hains, ECOHIA; L. Crowther, ExxonMobil; A. Chapman, Shell; M. Houston, Shell; P. van Hees, Orebro University / Environmental Engineering; A.D. Redman, ExxonMobil. Molecular properties such as chemical composition will vary depending on, amongst other things, the source of crude oil, the refinery processing and climate conditions. These substances present additional challenges when conducting environmental hazard and risk assessments under regulatory schemes such as REACH, and Concawe has developed bespoke models for these purposes. However, for purposes of hazard classification and labelling there is still a need for experimental aquatic toxicity test data on petroleum substances. Concawe substances have been organised into categories, based on similarities in refinery processes and physicochemical properties, resulting in a clustering of comparable chemical compositions and related hazard profiles. Applying read-across within a category is an established concept to fill in data gaps and to reduce unnecessary testing, and has been applied to available aquatic toxicity data for Concawe substances using a worst-case approach. ECHA recently released its Read-Across Assessment Framework (RAAF) for environmental endpoints, however the RAAF for UVCBs is still under development due to their added complexity. One recommendation of the RAAF when applying a category approach is to present data in a matrix to demonstrate that properties are similar or follow a regular pattern. In this presentation a category data matrix will be presented for the Concawe category of vacuum hydrocracked gas oils (VHGO). Available historical experimental aquatic toxicity data will be presented alongside substance identity information, predicted EL50 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (BE–SPME) screening studies. The latter is a technique which measures bioavailable hydrocarbons, and has been demonstrated to correlate well with experimental and predicted aquatic toxicity data. The resulting, complimentary dataset forms a wealth of evidence upon which to justify category approaches to the read-across of experimental toxicity data.
chemicals within the logKow range of 4.4-8.6 will be included in the study, and results from both methods will be compared.

MO437 Headspace passive dosing for dose-response testing of volatile hydrophobic organic chemicals

L.N. Tran, Technical University of Denmark / Environmental Engineering; N.S. Smedes, Technical University of Denmark / Department of Environmental Engineering; M. Holmstrøp, Aarhus University / Department of Bioscience; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

Constant and well-defined exposure is crucial for the toxicity testing of liquid organic chemicals with high Henry’s constants, which is prone to substantial evaporative losses. A simple and effective headspace passive dosing method was developed and then applied to control the exposure of the freshwater algae Raphidiocelis subcapitata and the terrestrial springtail Folsomia candida to terpenes and alkanes in toxicity experiments. The headspace passive dosing method applies a liquid partitioning donor placed in the headspace of the closed test vial for controlling exposure while avoiding direct contact and introduction of pure phase micro-droplets. Passive dosing from the pure liquid compound was applied for toxicity testing exactly at the solubility limit, and a dilution series of test chemicals prepared in purified vegetable oil served as donor for dose-response testing. The terpenes S(-)-Limonene and α(+)-Pinene were tested in both the algal growth inhibition test and the springtail test. In addition, n-nonane, n-undecane and n-dodecane were tested on the algae, while iso-octane, iso-dodecane and n-dodecane were tested on the springtails. Our first results demonstrated that (1) the headspace passive dosing method is a simple yet effective way to control exposure to volatile hydrophobic organic chemicals and (2) that the method is straightforward to apply in algal growth inhibition and springtail toxicity tests. Further analyses of exposure parameters are in progress to better understand and quantify the resulting toxicity.

MO438 Application of biomimetic solid phase microextraction to characterize aquatic hazard of petroleum substances

L. Cameron, ExxonMobil Petroleum and Chemical; A.D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; D. Letinski, ExxonMobil Biomedical Sciences Inc; E. Vaiopoulou, European Petroleum Refiners Association

Environmental hazards of petroleum substances differ in response to variable substance composition. In response CONCAWE has initiated a comprehensive analytical program to extend analytical characterization of petroleum substances to further support hazard classification within and across petroleum substance categories. As part of this work, SPME and toxicity data for newly characterized substances (n=139), across approximately 10 major categories, were compared to historical data. New compositional data were used as input to PETROTOX to predict acute toxicity. In this study, the compounds were divided into five groups. The predicted LE50s in the present work were shown to compare favorably with historically measured and predicted toxicity data. Further, experimental work was performed to estimate the bioavailable concentrations of hydrocarbons using biomimetic solid phase microextraction (BE) on water accommodated fractions (WAF) prepared with each substance at a nominal loading of 50 mg/L. This method simultaneously extracts and concentrates hydrophobic hydrocarbons onto a polydimethylsiloxane coated fibre which is then thermally desorbed unto a gas chromatography for quantification by flame ionization detection. The measured BE data provide an analytical surrogate that correlates to target lipid and hence WAF toxicity. New BE data showed similar agreement with earlier data collected on WAFs prepared with substances from the same categories. The BE method is a convenient predictive tool used to screen petroleum substances for testing. In summary, predicted toxicity and BE measurements for additional petroleum substances presented in this work strengthen the basis for aquatic hazard classification of petroleum substance categories.

MO439 Bioaccumulation factors of synthetic musks and other hydrophobic contaminants in mangrove molluscs

S. Baven, McGill University / Singapore-Delft Water Alliance; E. Segovia, H. Zhang, W. Lee, G. Juhl, National University of Singapore; F. Smedes, RECETOX / Environmental chemistry and modelling; B.C. Kelly, National University of Singapore / Civil & Environmental Engineering

The occurrence of a range of historical and emerging hydrophobic organic contaminants in mangrove ecosystems in Singapore. In particular, the levels of synthetic musk fragrance compounds, polychlorinated biphenyls, organochlorine pesticides and polycyclic aromatic hydrocarbons were measured in mangrove sediments, clams and caged mussels. In addition, the freely dissolved concentration of these organic chemicals in water was assessed with silicone rubber passive samplers. Results showed that polycyclic musks are present in mangrove ecosystems, and can accumulate in the tissues of molluscs. In the present study, bioaccumulation factors (B_{A\text{fw}} wet weights) were calculated for all the samples/sites and log B_{A\text{fw}} averaged 4.0±0.3, 4.4±0.3, 4.7±0.3, 3.9±0.7 and 4.3±0.4 for galadastol, traseolide, phantolide, celastolide and tonalide respectively. Overall, the empirical models fit reasonably well the bioaccumulation of polycyclic musks in both caged and native molluscs in tropical mangroves. The study of the bioavailability of hydrophobic compounds in highly dynamic environments such as mangroves can be sometimes intricate, and the usefulness of passive samplers and sentinel species such as bivalves was confirmed in the present study.

MO440 Effect-based characterization of mixtures of environmental pollutants in sediments collected between the Arctic and Australia

A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; M. Landmann, Helmholtz Centre for Environmental Research - UFZ GmbH / Department of Cell Toxicology; M. Bergmann, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research / HGF-MPG Group for Deep-Sea Ecology and Technology; J. Bräuning, The University of Queensland / Queensland Alliance of Environmental Health Sciences (QAEHS); S. Schaefer, Federal Institute of Hydrology / Biochemistry and Ecotoxicology; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry

ACES, B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology

There is a multitude of pollutants that combine persistent and hydrophobic properties. In aquatic environments, they are largely deposited in sediments. The amount and characteristics of the organic carbon determine how strongly they are bound or if they are readily available for partitioning to biota and biouptake. These pollutants can be accumulated by aquatic organisms and biomagnified to higher trophic levels. Hence, it is important to explore the composition, activity and effects of environmental mixtures of pollutants in sediments of different origin, characteristics and pollution history. Sediments from Sweden, the European Arctic (coastal Svalbard vs. open sea), Queensland (Australia) and a French-German river were collected. The freely dissolved concentrations (C_{free}) of the chemicals were determined using equilibration with thin coatings of silicone on the inner walls of glass jars with subsequent solvent extraction. Total sediment concentrations (C_{total}) were determined using accelerated solvent extraction. While there is a wide range of pollutants that have been detected in sediments world-wide, traditional chemical analysis cannot cover all compounds and their transformation products. Therefore, in this study, the extracts were dosed into seven cell-based bioassays covering cytotoxicity, activation of metabolic enzymes (binding to the arylhydrocarbon receptor, AhR), specific, receptor-mediated effects such as estrogenicity (ERa); and adaptive stress response (oxidative stress, AREc32). Cytotoxicity was assessed in all bioassays and occurred occasionally. Moreover, four of the seven bioassays were positive in 2012, the peroxisome proliferation receptor gamma (PPARg) and ERa. The activation of the AhR was by far most responsive and showed a distinct pattern across the sampling locations. The other three assays showed responses only at higher enrichment factors of the extracts, also revealing specific contamination patterns. A comparison between C_{free} vs. C_{total} will enable assessing the actual risk (C_{imp} vs. C_{pot}) of the potential hazard of those chemicals that might be inhaled in future scenarios (C_{bio}) based on bioaccumulation assessment, based on exhaustive extraction of HOCs followed by lipid-normalisation, cannot distinguish between cases when bioaccumulation is driven by bioconcentration (passive uptake) or by bioavailability (uptake + resorption). This shortcoming obstructs the distinction of HOCs transfer in aquatic food webs, across trophic levels and between environmental compartments (sediment, water, biota). The recently proposed approach based on using ratios in chemical activity as a metric for bioaccumulation assessment represents a major advance relative to the traditional ones, since it aims at expressing the data on a common basis to enable direct comparison among compartments. Passive sampling devices (PSD) are considered a promising alternative to traditional bioaccumulation assessment and LIFIT (laser induced fluorescence imaging technique) is used for non-invasive detection of organic pollutants in sediments and water. This non-invasive analysis is likely to be used for monitoring of pollutants in sediments and water, as well as in aquatic samples.
lipid), have been selected to optimise silicone-based PSDs for sampling in lean tissues. For this study, silicone is used as common reference phase, with sampler relocations across the homogenated samples along the sampling period, as has been proposed by Rusina et al. [1], in order to avoid the local depletion of the sample in direct contact with the silicone, and both, kinetic and equilibrium approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180) have been selected as target compounds, covering a lip/Kow range from 5.66 to 7.15.

MO442 Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, malapoea in the northern Gulf of Mexico

S. Chiasson, Loyola University / EEB; E.K. Grey, Governors State University / Division of science, mathematics, and technology; D.A. Grimm, Tulane University / Coordinated Instrumentation Facility; C.M. Taylor, Tulane University / Ecology & Evolutionary Biology

The blue crab, Callinectes sapidus, is an ecologically and economically important invertebrate species in the northern Gulf of Mexico (NGOM). The NGOM receives nearly 60% of drainage from the river systems in the continental United States. Blue crab megalopa collected over three years from multiple estuaries in the NGOM suggests that management strategies of alkylphenols in the common source. The relatively high NP concentrations detected in juvenile blue crab megalopa in 2010 and 2011 exceeded the lower limit of the No Observed Effect Concentration range for aquatic invertebrates set by the U.S. Environmental Protection Agency. BHT is a common preservative in food, pharmaceuticals, and cosmetics and is considered safe. DTBP is a marine pollutant, but exhibits low toxicity. All these compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in megalopa over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment should be re-evaluated to mitigate potential sub-lethal effects of exposure to blue crab populations.

MO443 Real-time visualization and quantification of perylene bioaccumulation at single cell level

X. guo, School of Environment, Beijing Normal University; X. Jin, Beijing Normal University; F. Bai, Peking University

Hydrophobic organic chemicals (HOCs) are of special ecological concern because they can be directly incorporated and bio-concentrated in living organisms. However, the effects of self-clustering of HOCs on their environmental behavior and potential clustering is considered to be one of the main factors for marine pollutants, but exhibits low toxicity. All these compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in megalopa over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment should be re-evaluated to mitigate potential sub-lethal effects of exposure to blue crab populations.

Ecotoxicology faces the challenge of monitoring the levels of an increasing number of chemicals on biota. While persistent pollutants have been largely studied, several pollutants are metabolized, especially by vertebrates. Despite the higher toxic potential of metabolites compared to their parent compounds, little attention has been given to metabolites. Several persistent micropollutant families (Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCP)) and metaboleable ones (Polyyclic Aromatic Hydrocarbons (PAH), phthalates, pyrethroid pesticides), as well as their metabolites were measured in a free-living freshwater fish, the European chub (Squalius cephalus, N = 113) caught by electrofishing operations in the Seine watersheds. The occurrence of pollutants was characterized in muscles and their metabolites in bile and liver using gas chromatography (GC-MS / MS) and high performance liquid chromatography (HPLC-MS / MS) coupled to a mass spectrometer. Body burdens of pollutants in chubs were then explained according to the environmental (water surface and sediments) contamination and individual parameters (age, body length, health status and parasitic load). Despite restrictive legislation, persistent pollutants (OCP, PCB) were found in all environmental matrices and fish tissues. Pheralates were the most abundant chemicals, with concentrations in fish tissues in the range 416-2200 pg g⁻¹. Positive correlations were detected between the environmental pollution and the levels of persistent pollutants (PCB, OCP) in chubs, but not for the metabolizable chemicals, likely due to their rapid degradation and excretion. No correlation was found between micropollutant levels and health status of chubs, suggesting low ecotoxicological effects of these contaminants exposure in the Mame hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. In the study of POP in lipid, P. laevis were less contaminated. 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MO448
Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain
F. Ko, National Museum of Marine Biology and Aquarium, National Dong Hwa University, PhD project funded by Marine Bio Research Challenge Fund, Taiwan, Republic of China.
Bioaccumulation and distribution of polycyclic aromatic hydrocarbons (PAHs) over different amounts of exposure time were investigated in the plankton food chain including phytoplankton and zooplankton. The simulated plankton food chain was using phytoplankton (Tetraselmis chuii), rotifers (Brachionus sp.,) and copepods (Acartia clausi) cultured in a gas purging system with a steady supply of PAHs for 7 days in this study. The results show that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-24 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-24 hour time intervals, then approached study-state at 24-168 hours exposure. The low molecular weight PAHs (ACN, AC) were found at significantly higher levels compared than in high molecular weight PAHs (FA and PY) were found at significantly higher levels in phytoplankton, indicating that plankton might have selectivity towards PAHs. In principal component analysis (PCA), the plankton could be separated significantly into phytoplankton and zooplankton. Parts of the PAH accumulation found in rotifers and copepods were similar, demonstrating that PAH composition in plankton might be affected by trophic levels. All PAHs demonstrated significantly linear relationships between bioconcentration factor (BCF) and PAH hydrophobicity (Koc) in plankton, however the different linear regression slopes of log BCF and log Koc, between phytoplankton, rotifer and copepod, suggested that the plankton have different pathways of PAH accumulation.

MO449
Do weathered multiwalled carbon nanotubes influence the distribution of the biocide triclocarban in a sediment-water system?
L. Benner, L. Politowski, M.P. Hennig, H. Hollert, RWTH Aachen University, Institute for Environmental Research, Environmental Chemistry and Environmental Biology (SPHERE Research Group)
Multiwalled carbon nanotubes (MWCNT) are widely used nanomaterials in a variety of different products and processes, well-known for their high sorption capacity. Due to increasing usage and production, exposure to the aquatic environment either accidentally or via disposal of CNT-containing products might increase likewise. Weathering processes like radiation can alter nanoparticle properties and lead to a decrease in their environmental retention. The fate of MWCNT in the water phase is very short; due to agglomeration and aggregation processes they preferably settle down in sediments, which represent a potential sink for carbon-based nanomaterials. Nevertheless, during their stopover in the water phase they may interact with water dissolved xenobiotics, and thus alter the fate of these substances. Due to the lack of information on the influence of MWCNT on organic chemicals in aquatic ecosystems, proactive research is needed to estimate potential risks, especially for sediment-dwelling organisms as a part of the 'Trojan Horse' effect. In the present study MWCNT were irradiated by simulated sunlight (300-400 nm) for 90 days. The weathered MWCNT (wMWCNT) were used to investigate their influence on fate and distribution of the biocide triclocarban (TCC) in a sediment-water system. This substance was chosen because of its hydrophobic properties and strong affinity to sorb on MWCNT. The concentration of wMWCNT has a significant impact on the distribution of TCC in natural water. 100 µg and 1000 µg wMWCNT/L in MilliQ water led to an adsorption (log kowMWCNT in OECD medium: 7.6 L/kg) of 100% and 65% 14C-TCC respectively. We will report experiments on the distribution of TCC in water with different concentrations of wMWCNT for 2 h with 1 mg wMWCNT/L and subsequently incubated in a sediment-water system in the dark for 180 d. A scenario with 14C-TCC will only serve as control. TCC is expected to sorb onto the wMWCNT and accumulate in the natural sediment by fast sorption of wMWCNT-TCC complexes. Production and release of carbon based nanomaterials are predicted to further increase in the near future, thus the interactions of nanomaterials with organic pollutants will be of growing importance to assess environmental consequences. Acknowledgements: The work is supported by the European Project NANO-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SINN.

MO450
When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule
B. Journel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA
Due to substances in the environment are driven by numerous factors. Among them, substance’s properties such as Henry’s constant (i.e. water solubility and volatility) and hydrophobicity (in terms of Koc and adsorption) have a non-negligible impact on how substance’s behaviour is modelised in the different compartments (soil, water, sediment, air), to predict exposure levels in risk assessments. Pharmaceuticals represent a specific category of substances as they are difficult to analyse and experimental results more subject to imprecision. Due to analytical difficulties, parameters such as water solubility and Koc are often expressed as “lower than” or “higher than” and have no defined value. Additionally, model softwares such as EUSES impose maximum value for Koc and minimum value for water solubility as input parameters, whereas EU TGD spreadsheet allows to consider the experimental results. The decision on the parameter values and models to be considered needs then expert judgment. We will present the case of a pharmaceutical molecule currently studied, for which water solubility and then Koc, cannot be precisely measured experimentally. While staying regulatory compliant and reflecting the experimental results, the input values chosen for these parameters have a significant impact on calculated PECs for this insoluble molecule. Studies on fate and behaviour in soil and water/sediment systems are to be conducted, however considering the technical difficulties to analyse the molecule, and the route of environmental exposure, it may be necessary to define a category of molecules for which some of current regulatory requirements could be waived related to their chemical properties. A proposal for an appropriate risk assessment will be provided.

MO451
Effect of environmental characteristics on the bioavailability of hydrophobic organic compounds to fresh water organisms from natural aquatic systems
L. Teunen, University of Antwerp; C. Belpaire, Research Institute for Nature and Forest INBO; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)
Many aquatic ecosystems are under persistent stress due to influxes of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the targeted chemical compounds are measured in the water and not in aquatic organisms. Nevertheless, in the case of highly hydrophobic compounds, their very low water solubility precludes direct measurement in water, and thus alternative monitoring strategies are needed. Accordingly, the WFD has formulated biota quality standards (BQS) which refer to concentrations of compounds that have to be monitored in fish and invertebrates. In the present study we are investigating the reliability and relevance of BQS by studying the relationships between concentrations of hydrophobic compounds in environmental compartments (mainly in sediment) and concentrations in biota. Our study encompasses 22 field locations at which we are monitoring the concentrations of a set of hydrophobic organic compounds and total Hg in both sediment and biota (fish and mussels). In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are measured and water characteristics are monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being established to construct the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO452
Personal care products (PCPs) in the southeastern coast of Brazil: Determination of the occurrence, distribution and biological exposure
T. Combi, Instituto Oceanográfico da Universidade de São Paulo / Instituto Oceánico; R.C. Montone, Universidade de Sao Paulo / Oceanographic Institute
The use of large amounts and a broad variety of chemicals that are potentially harmful to the environment (including persistent organic pollutants (POPs), pharmaceuticals and personal care products (PCPs)) is a concern for the protection of environmental samples. In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are monitored and water characteristics are monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being established to construct the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.
have been recently detected. Consequently, their study has become a priority among the main bodies responsible for protecting public health and the environment, such as the European Commission and USEPA. However, the current knowledge about the occurrence and fate of PCPs is still scarce, especially in less developed or developing countries as Brazil. Thus, this study aims to evaluate the occurrence of PCPs in surface sediments of selected areas along the southern and southeastern Brazilian coast through the optimization and implementation of a state of the art methodology. Preliminary results obtained by surface sediment samples from São Paulo coastal areas through microwave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyzes (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EHMCF) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction salients and clean-up procedures to improve the detection and quantification of these compounds. The final results of this work will provide the first extensive dataset on the occurrence, levels and fate of PCPs in the Southern Atlantic which will not only contribute with new and rather scarce data but also with valuable information for regional and global inventories.

MO453
IFRA Environmental Standards and RIFM Safety Assessment Program Advances Update for 2018
A. Lapczynski, RIFM / Environmental Science; D.T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; C. Gonzalez, IFRA
To assure safety of fragrance ingredients in consumer products, International Fragrance Association A.K. is working to maintain the fragrance industry’s self-regulatory safety program with the development of IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessments for these Standards are incorporated in the Research Institute for Fragrance Materials’ (RIFM) testing program in coordination with its Expert Panel. To identify materials for risk assessment refinement, fragrance materials were screened using the RIFM Environment Framework and 2008 IFRA volume of use survey as reported for both Europe and North America. The Framework for this evaluation was published in Environment Toxicology and Chemistry (Salvito et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank materials for risk assessment refinement in an effort to provide greater transparency to the IFRA Environmental Standards. RIFM reports the most recent results of these additional tests (for both risk and hazard assessments) at both the annual SETAC NA and Europe meetings. These studies include persistence testing (ready biodegradation tests and die-away studies), bioaccumulation, and acute and chronic aquatic toxicity. Incorporating these new data in a second tier risk and hazard assessment for these materials will also be presented.

MO454
Comparison of different sampling techniques for the identification fire effluents from low-density polyethylene burning
A. Bahjat, King Fahad Security College / Forensic Science Department; A.A. Stec, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing; Y. Badjah-Hadj-Ahmed, King Saud University / College of Science, Chemistry Department; R. Hull, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing.
High amounts of various polymers are being used in many fields with numerous benefits. However, their great ability to ignition and rapid flame spreading make these materials dangerous for human life and properties due to the release of highly toxic combustion products. The present work aims to investigate several methods of sampling and analysis of polyolycyclic aromatic hydrocarbons (PAHs) produced by controlled burning of low-density polyethylene (LDPE) using a toxicity tube furnace. Five different sampling methods were used: solid phase micro extraction (SPME), syringe, telluric bags, sorption tubes, and gas-solution absorbers. The produced hydrocarbons were analysed by gas chromatography coupled to mass spectrometry with and without pyrolysis. The analysis of PAHs released from polyethylene combustion showed that emissions with a potentially negative impact on the human health and the environment are produced in significant concentrations. Among the tested techniques, the most convenient sampling method was that using syringe with a glass vessel which allowed detection of the highest amount of PAHs at both 800 and 600°C, then followed by SPME. On the other hand, the use of gas-solution absorber (midget impinger) showed poorer results. Regarding the use of telluric bags and sorption tubes, they didn't give satisfactory results. Several carcinogenic or possibly carcinogenic compounds were identified in the combustion products, such as benzene, naphthalene, anthracene and pyrene.

MO455
PbTk modelling of super-hydrophobic chemicals
W. Lutsch, C. Goss, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry
It is a widespread opinion that super-hydrophobic chemicals are not taken up by fish [1–3]. But so far, we haven’t seen sufficient evidence why they should not cross membranes or aqueous boundary layers, although these processes might be kinetically slow. Super-hydrophobic chemicals are very challenging for controlled exposure experiments. Here we use the few existing data points of a fish feeding study with Dechlorane (log Kow (estimated) = 11.6) with our recently published PbTk model, TK-fish, to shed more light on this issue. We first validated the oral up-take pathway in our model and found that facilitated transport via albumin and bile micelles through the aqueous boundary layers must accounted for, for hydrophobic chemicals such as HCB in order to get correct results. Subsequent simulations with the super-hydrophobic chemical Dechlorane revealed that for an oral uptake route the diffusive transport through aqueous boundary layers in the gastro-intestinal tract and in the blood is indeed the limiting process. Good agreement of the predicted model results with measured values indicates that there is no principal hindrance for the oral up-take of super-hydrophobic chemicals. The results also indicate that it would take roughly 2 years or more for a steady state to be established which is too long for an experimental exposure study. 1. Dyer SD, Bernhard MJ, Cowan-Ellsberry C, Perdu-Durand E, Demmerle S, Cravedi J-P. 2008. In vitro biotransformation of surfactants in fish. Part 1: linear alkylbenzene sulfonate (C12-LAS) and alcohol ethoxylate (C13EO8). Chemosphere. 72:850—862. 2. Sakurutani Y, Noguchi Y, Kobayashi K, Yamada J, Nishihara T. 2008. Molecular size as a limiting characteristic for bioconcentration in fish. J. Environ. Biol. 29:89—92. 3. 2016. Guidance on Information Requirements and Chemical Safety Assessment, Chapter R.11: PBT/ vPvB assessment Draft Version 3.0, European Chemicals Agency, Helsinki. https://echa.europa.eu/documents/10162/23047722/fr_csa_r11_pbt_pegs_en.pdf/dd ac9031-ua44-4995-8ecf-3738162ba4e5

Migratory bird species at risk - the role of pesticides and other chemicals (P)

MO456
Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
C.A. Bishop, Environment and Climate Change Canada / Wildlife Research Division

MO457
Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
P. Berny, VETAGRO-SUP / Toxicology

MO458
Main scientific gaps in knowledge of risk from Pb ammunition and shot to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
R. Cromie, Wildfowl & Wetlands Trust

MO459
Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
M. Taggart, University of the Highlands and Islands / Environmental Research Institute

MO460
Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally
M. Odins, Independent Environmental Services Professional

Big data analysis in ecotoxicology: how to get new information out of existing data? (P)

TU001
Holistic evaluation of long-term field effect earthworm studies with the fungicide Boscalid
F. Slaab, BASF SE; J. Roembke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, BASF SE; S. Braeker, BASF France S.A.S.
In order to place a plant protection product on the market, the product and its active substances need to demonstrate an acceptable risk to earthworm communities. The current European risk assessment scheme follows a tiered approach using worst case environmental concentrations and endpoints from earthworm reproduction laboratory studies in tier 1. For the active ingredient Boscalid no risk to earthworms has been identified based on the chronic laboratory studies provided by BASF to EU registration authorities. However, for one of the formulated products containing Boscalid the tier 1 assessment did not allow to exclude a potential
long-term risk to earthworms in the field. Therefore, a comprehensive field study program was conducted in different crops and field sites in Germany between 2000 and 2010. The study program went beyond regulatory requirements and comprised 6 independent long-term field studies that ran up to five years and were accompanied by a comprehensive residue analysis program. The number of earthworm field data generated is - to our knowledge - one of the highest ever collected for one plant protection product. We evaluated the extensive data set using the "Code Mapping" tools providing representativeness/comparability of examined earthworm communities, site- and soil properties of the different locations as criteria in the analysis. Based on these criteria a statistical assessments of representative and comparable earthworm communities in relation to the field exposure were conducted. The assessment revealed that – using data from representative and comparable study sites - there was no concentration related effect of a five-year use of the product regarding diversity and abundance of different earthworm communities.

TU002 Contextualising statistically significant differences observed in mesocosm studies using historical control data
K. A. Hassen, RWTH Aachen University; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research

A novel adverse outcome pathways and networks, and assist in predicting species to NCBI taxids and 3) mapping all chemicals within ECOTOX 2) mapping s

TU003 Enhancing the utility of the ECOTOX knowledgebase via ontology-based semantic mapping

TU004 ECOTOX Knowledgebase: New tools for data visualization and database interoperability

The ECOTOX{T}oxicology knowledgebase (ECOTOX) is a comprehensive, curated database of ecotoxicological data from single chemical exposure studies to terrestrial and aquatic organisms. The ECOTOX knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemical substances for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g. Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 100 data fields. Study details such as species, autecological hierarchy, chemical purity, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, ECOTOX has aligned the coding of the aquatic and terrestrial references by the addition of data fields, adapted search terminology to better focus literature searches, and updated search screens. To meet the data needs of 21st century toxicology assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases have been employed to assist in efficiently accessing necessary data. The expanded search options will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.

TU005 Edaphostat - A web application for automated and interactive meta-analysis of environmental data from the Edaphobase data warehouse
K. A. Hassen, RWTH Aachen University; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research

Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from numerous different databases and research programs. Usage of these databases promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automated analysis tools, which are customized for certain data warehouse applications, can be a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/). Edaphobase performs several steps of data cleaning, formatting, and transformation to make datasets comparable. Preprocessed data are analyzed and the results are visualized as interactive plots and dashboards. The tool depicts species distribution alongside environmental gradients (for example pH and C/N) and habitat parameters (such as soil classes) and species settlement in ecological niches. Edaphostat makes use of the core functions of the Edaphobase data warehouse (e.g. upload and retrieve data, search data) and adds new analysis tools customized for certain data warehouse applications to assess species-specific autecological preferences and ecological niches.

TU006 Deriving USEtox aquatic freshwater toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program
E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; A. Gissi, European Chemicals Agency; P. KARAMERTZANIS, ECHA European Union, European Chemicals Agency; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research

The ECOTOX knowledgebase (ECOTOX) is a comprehensive, curated database of ecotoxicological data from single chemical exposure studies to terrestrial and aquatic organisms. The ECOTOX knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemical substances for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g. Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 100 data fields. Study details such as species, autecological hierarchy, chemical purity, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, ECOTOX has aligned the coding of the aquatic and terrestrial references by the addition of data fields, adapted search terminology to better focus literature searches, and updated search screens. To meet the data needs of 21st century toxicology assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases have been employed to assist in efficiently accessing necessary data. The expanded search options will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.
and toxicity indicators for thousands of chemicals to be used in the USEtox model. The poster presents the methodology applied for the selection of the aquatic toxicity data available in REACH, the set of criteria used to derive various level of quality data to meet the requirement to produced Effect Factors for as many chemical as possible, and the various calculation procedure to derive final chemical effect factors. Correlation between acute and chronic toxicity for thousands of tests, for each endpoints groups, was established, as well as the feasibility to calculate effect values based on Species sensitivity distribution. The following final calculation has been performed for thousands of chemicals: - Acute and Chronic species geometric means with standard deviation and number of individual test available per species - Arithmetic average of all the log of the species geometric mean with standard deviation and count of species as well as count of SSD group for each chemical - Arithmetic mean and ChE geometric means with standard deviation - Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TU007
Deriving physico-chemical input data for the USEtox model from the REACH database for thousands of chemicals using R-Studio program.

F. Bignanelli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; S. Proenca, EU Commission Joint Research; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). The potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model. This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life (toxicity to fish) as well as data for cancer and non-cancer effects. For PEF/ OEF, these data are required for thousands of chemicals using the most up-to-date information. The EU commission Joint Research Centre has obtained from the chemical agency (ECHA) for more than eight thousand chemicals data regarding physico-chemical properties (166 926 test results, as of March 2017) available in the IUCLID 5.5 database. These data have been processed to automatically derive accurate values for six of the physico-chemical properties required by UseTox for fate modelling: Kow, Koc, vapour pressure, water solubility, Henry law constant and biodegradation; in addition, adsorption partition coefficient (Kd) to suspended matter, sediments and soil for inorganic compounds were determined. In order to provide high quality results, criteria were applied for selecting data on the basis of their reliability (assessed by Klimasch scores), purpose and study type. Moreover, other specific criteria were defined for each properties according to the method used, such as experimental condition (temperature and pH). Geometric mean and the coefficient of variation, for their reliability evaluation, of the consistent data selected was performed. A correlation analysis of the results with values previously included in USEtox and with values obtained with computational methods (Qsar/qspr) was established to assess the quality of this proposed automated approach. A quality levels approach is proposed. This, paired with the abovementioned statistical index, represents a helpful support to the user for evaluating the reliability of each parameter used in the fate model. For chemicals with no available data or not satisfying the minimum quality requirements, physico-chemical properties were derived using in-silico tools (qsar/qspr). In particular, OECD QSAR toolbox and the EPIsuite estimation models played a fundamental role for this data gap filling purpose.

TU008
Toward a possible Toxicity Test Battery Integrated Index for Nanomaterials

M. Oliviers, University Parthenope; s. schiavo, ENEA CR; s. manzo, ENEA / SSPT-PROTER-BES

Nanotechnology is a rapidly expanding field of research continuously producing novel materials with nanoscale properties (nanomaterials, NMs), as result, it is inevitable that NMs will enter the aquatic environment. Usually the ecotoxicological approach is generally based on a battery of bioassays with organisms belonging to trophic levels other than the aquatic end point for each species. While these endpoints, taken individually, can indicate the presence of a potentially deleterious effect, it is often difficult to combine these effects into an assessment of the overall status for the selected environment. Therefore is necessary to integrate all results to evaluate the risk for NMs. To synthesize the results obtained with a battery of ecotoxicological tests, different approaches were developed such as Toxicity test battery integrated index (TBI). This index has the advantage to put in evidence the differences between the samples. However there are still some open issues and TBI integration procedure needed to be modified according to testing sample or substance in order to represent the test sensitivity towards the matrices. In particular, when NMs are investigated also different physico-chemical behaviour and interaction with organisms should be taken into account. Therefore, the aim of this work is to study the suitability of TIB procedure for the NM to determine the needed modification for tailoring the data integration. In particular, we considered metal bearing nanoparticles (NPs) such as TiO₂, SiO₂ and ZnO and a battery of toxicity test with organisms of different biological complexity and representative of different trophic levels with the aim to establish a unique toxicity ranking. From the analysis of the results integration with TBI could be highlighted that to define the hazard associated with NPs is necessary to tailor the index parameters on specific NMs physico-chemical characterization. Moreover, to make the results more reliable, together with a larger number of tests, a longer testing time for some organisms and other endpoints (genotoxic and cytotoxic parameters) should be utilized.

TU009
Historical analysis of the use of plant protection products in apple orchards (1970-2014):
Combining handwritten farmers records with electronic data

L. de Baan, Agroscope / Institute for Plant Production Sciences IPS; M. Mathis, J. Stricher, Agroscope; O. Daniel, Agroscope / Institute for Plant Production Sciences IPS

Plant protection products (PPPs) are used to protect crops against pests and diseases and ensure yields and quality of crops. Because they are biologically active, they can cause negative side effects on the environment or humans. Data-sets on the use of PPP for specific crops over a long time would allow to get a better knowledge on their potential environmental impact, in a way that goes beyond agro-ecosystems. However, the consistent long-term datasets are mostly lacking. In addition, historic farmers’ records are often only available in handwritten paper format. In Switzerland, data on PPP use in apple orchards has been voluntarily recorded by farmers since the 1950-ies, to evaluate farm economics. Up to the 1990-ies, data were only available in handwritten paper format, since 1997 they were collected electronically. In this study, we digitised the handwritten records and combined it with the electronic data. We first developed a concept, how the handwritten records can be entered into a database, which contains similar information as the electronic data. We collected data on farms (productivity), apple plantations (year of plantation, size, type, variety), and plant protection measures per plantation (product, dosage, date of application). In We also developed procedures to handle missing data and to detect data quality in the indicated dosage or field size. Finally, a dataset of spray sequences in apple orchards over the period 1970-2014 was analysed, regarding the number of treatments per PPP category (e.g. fungicides), the total amount of active ingredients applied per season and PPP category and the ranking of chemical groups per PPP category. While the average number of treatments and the average amount of active ingredients remained within a similar range, major changes were detected in the composition of applied active ingredients. For example, in the 1970-ies and 80-ies, more than 75% of all insecticide treatments were organophosphates. After 1986, organophosphates were quickly replaced by carbamates and benzoylureas, and today only contribute to about 10% of all insecticide treatments. This study illustrates, that for a historic analysis of pollutants it is sometimes unavoidable to fire potential handwritten data, but will increase the digital data quality. However, this trend resulted in a unique 44 year time series of PPP use in apple orchards. In a next step, we will analyse the historic development of ecotoxicological risks of PPP usage in apple orchards.
Research

We characterized spatial patterns of surface sediment concentrations of seven polychlorinated biphenyls (PCBs), seven polycyclic aromatic hydrocarbons (PAHs), three chlorinated pesticides and five metals in Norwegian waters and Skagerrak. In total, we analysed 5,036 concentrations of 22 chemical substances that were measured between 1986 and 2014 at 333 sampling sites by means of generalized additive models (GAMs). We found that GAMs with organic carbon content of the sediment and latitude and longitude as covariates explained ca. 75% of the variability of the contaminant sediment concentrations. For metals, a predominantly hotspot-driven spatial pattern was found, i.e. we identified historical pollution hotspots (e.g. Sørjford in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated and industrialised regions, i.e. in the North Sea and in the Kattegat and Skagerrak. The spatial pattern of the PCBs suggests the secondary and diffuse atmospheric nature of their sources. Atmospheric inputs are the main sources of pollution for most organic chemicals considered, but north of the Arctic circle, we found that concentrations of PAHs increased from south to north most likely related to a combination of coal-eroding bedrock and the biological pump. The knowledge acquired in the present research is essential for developing effective remediation strategies that are consistent with international conventions on pollution control.

TU012 Application of a ‘weight-of-evidence’ model for assessing sediment quality and associated hazard with offshore gas platforms discharging produced water A. Tornambè, ISPRA Institute for Environmental Protection and Research; G. Martuccio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; L. Manfra, R. Di Mento, G. Mol tedo, B. Catalano, ISPRA Institute for Environmental Protection and Research; G. Martuccio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; C. Sibbio, G. Chiarreti, O. Faraponova, M. Amici, C. Maggi, G. Romagnoli, G. Sesta, G. Granato, F. Venti, P. Lanera, S. Mutili, F. Onorati, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; J. Hassett, J.D. Rocca, S. Wang, Duke University / Biology department; C.R. Violin, University of North Carolina at Chapel Hill / Biology department; E.S. Bernhardt, Duke University / Biology department.

Environmental quality assessments and monitoring plans are key tools to all stakeholders to drive sustainable development. Conventional methods often lack the capacity to address the complexity of multidimensional contaminant systems. To better summarize complex dataset of results, providing a more realistic evaluation of hazard and risk for produced water discharges. We applied a weight-of-evidence (WOE) model for produced water discharges. The WOE elaboration allowed to better characterize the impact of stressors and especially pollution on microbial community structure. However, the overwhelming amount of information generated by sequencing and the high diversity of microorganisms led us to focus our analyses mainly at the community or phylum levels, ignoring all the key ecological knowledge potentially gained at the population level. In this study, we tried to move beyond biodiversity approaches and explore the full potential of high-throughput sequencing data by characterizing the response of individual taxa (OTUs) to different stressor gradients and identifying bacterial indicator taxa.

Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring (P)

TU014 Identifying bacterial indicator taxa along an urbanization gradient in stream ecosystems M. Simonin, Duke University / Biology; K.A. Voss, Regis University; B.A. Hassett, J.D. Rocca, S. Wang, Duke University / Biology department; C.R. Violin, University of North Carolina at Chapel Hill / Biology department; E.S. Bernhardt, Duke University / Biology department.

The impact of high throughput sequencing enabled microbial ecotoxicologists to better characterize the impact of stressors and especially pollution on microbial community structure. However, the overwhelming amount of information generated by sequencing and the high diversity of microorganisms led us to focus our analyses mainly at the community or phylum levels, ignoring all the key ecological knowledge potentially gained at the population level. In this study, we tried to move beyond biodiversity approaches and explore the full potential of high-throughput sequencing data by characterizing the response of individual taxa (OTUs) to different stressor gradients and identifying bacterial indicator taxa. We identified bacterial taxa that were negatively impacted by urbanization than positively impacted stressors. Using TITAN, we identified more bacterial indicator taxa along an urbanization gradient in stream ecosystems in the Raleigh-Durham area (North Carolina, USA). We used a combination of environmental variables (% development, % forested, sediment Zn concentration, biotic index) that were significantly correlated to bacterial community structure to identify reliable bacterial indicator taxa along this multiple stressor gradient. Using TITAN, we identified more bacterial indicator taxa negatively impacted by urbanization than positively impacted (138 and 56 OTUs, respectively). Using quadratic regressions, we found 140 OTUs presenting a subsidy-stress response to the gradient. We observed that two bacterial families were strongly and consistently decreased by urbanization: Acidobacteriaceae (Acidobacteria) with 50% of OTUs identified as pure and reliable indicator taxa and Xanthomonadaceae (Alpha-Proteobacteria) with 39% of indicator taxa. Positive responders were distributed all over the phylogenetic tree and the family Comamonadaceae (Beta-Proteobacteria) presented the highest number of indicator taxa (14%). We calculated with TITAN that the community-level threshold, indicating the peak along the gradient where the maximum decline in all negative responders happened, was at 12.1% development. This community-level threshold occurs at very low levels of urbanization patterns and explores the full potential of microorganisms to urbanization and the potential of bacteria to be used in biomonitoring or monitoring along with more traditional indexes.

TU015 Diuron sorption in freshwater biofilms: determination of isotherms B. Auelmet, ISTRA; J. Hassett, J.D. Rocca, S. Wang, Duke University / Biology department; C.R. Violin, University of North Carolina at Chapel Hill / Biology department; E.S. Bernhardt, Duke University / Biology department.

In 2000, the EU Water Framework Directive (directive 2000/60/EC) was implemented with the objective of reaching the good ecological status of rivers. 45 chemicals were indexed as priority including 19 pesticides. The biofilm is at the basis of the trophic chain in aquatic environments and considered as an excellent bioindicator for water quality assessment (Edwards and Kjellnerup 2013) because of its persistence and widespread distribution displaying a high level of diversity. In this study, we used a photosynthesis inhibitor herbicide: diuron, one of the priority substances as bioindicator or monitoring along with more traditional indexes. To that aim, mature biofilm previously grown on glass slides
during one month was exposed in channels at 6 increasing concentrations of diuron: 0, 1, 5, 10, 25, and 50 µg.L⁻¹ for two hours, with a flow velocity of 2 cm.s⁻¹. Then, Langmuir isotherm equation (Praus et al. 2007) was fitted to the bioaccumulation data. During the determination of the isotherm, a plateau was reached over 5 µg.L⁻¹ of diuron in the water. This suggested that all absorption sites were saturated, and then diuron concentration in the biofilm became independent of diuron concentration in the water. The fitting of a Langmuir isotherm allowed to estimate a maximum adsorption capacity in the biofilm of 1073 µg g⁻¹, and an equilibrium constant of Q=0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlight a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the effect of diuron on the maximal capacity of the biofilm regarding diuron uptake. These two constants can be used to further prediction of diuron bioaccumulated in biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about behavior and impact in periphytic microorganisms.

TU016

New insights into the biotransformation of sulfonamid: role of ammonia oxidizing bacteria and community shifts

T. Yin, National University of Singapore / Civil and Environmental Engineering; Y. Yang, S. Te, National University of Singapore; K. Gin, National University of Singapore / Civil & Environmental Engineering

Emerging organic contaminants (EOCs), such as perfluoroalkyl and polyfluoroalkyl substances (PFASs), are ubiquitously detected in the environment and have raised increasing concerns due to their adverse effects on ecosystems and humans. N-ethyl perfluorooctane sulfonamide (N-EtFOSA), belonging to PFASs, is used as the active ingredient in the pesticide, Sulforamid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have investigated diuron bioaccumulation in different aquatic sludge, marine sediments and soil. However, little information is available on the contributions of different microbes to the biotransformation of N-EtFOSA. This study used allylthiourea (ATU), an inhibitor of ammonia monooxygenase (AMO), to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on its biotransformation. ATU-treated sample was more diverse with a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protochlorambium increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

TU017

How can three herbicides impact the fatty acids of the freshwater diatom Gomphonema gracile?

F. Demailly, IRSTE Bordeaux / Iferrem Nantes / EPOC (LPTC) / UR EABX; M. LE GUEDARD, LEB AQUITAINE TRANSFERT-ADERA / LEB AQUITAINE TRANSFERT; M. Eon, B. Delest, Istea Bordeaux / UR EABX; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; N. Mazzella, S. Morin, Istea Bordeaux / UR EABX

Fatty acids are essential elements for the structure of biological membranes and for the storage of metabolic energy. They are used as a source of energy by metabolism at each trophic level, making fatty acids biochemically and physiologically important compounds (Neves et al. 2015). In the trophic chain, many fatty acids are only synthesized by microalgae and bacteria before being transferred via herbivorous invertebrates to fish and ultimately to humans (Arts et al. 2001). For example, highly unsaturated fatty acids (HUFAs) such as eicosapentaenoic acid (EPA; C20:5n3), can not be synthesized de novo or in insufficient proportions by animals, thereby imposing a demand on the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used as nanofertilizers as their nanoscale size provides a high surface area per weight. The growing interest in the use of metal NPs in agriculture might be explained by the release of nanoparticles, which can be distributed in the environment. The use of nanoparticles in agriculture is expected to increase in the future. The present study aimed to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on its biotransformation. ATU-treated sample was more diverse with a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protochlorambium increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

TU018

Effects of Nickel on cell cycle progression, growth and antioxidant enzymes of green algae C. reinhardtii

M. Saenz, PRIET CONICET, National University of Luján; k. Bisova, Laboratory of Inorganic Chemistry, Biology, and Environmental Sciences, Institute of Microbiology, W.D. De Mario, CONICET-PRIET / PRIET

Freshwater ecosystems received industrial and domestic sewage discharged and natural chemical compounds as a result of anthropogenic activities. Heavy metals released in the environment have increased over the last decades causing environmental and human health problems worldwide. The known biological adverse effect of metals includes growth disorders, stress responses, oxidative stress and pigments synthesis pathways, induction of oxidative stress, mutagenic effects, among others. Among aquatic organism, microalgae have an important role in aquatic system as they are a key component of food chains. So that, it is crucial to has early assessment tools to evaluate effects of metals at the cellular level. In the present study effects of Nickel was evaluated on cell cycle progression, growth and antioxidant enzymes kinetic of the green algae C. reinhardtii. Synchronized cultures of this multiple fission dividing algae were used for the study. Ailquod from growing cultures were taken hourly during 36 hours. The attainment of commitment points (CP) was evaluated by transferring hourly aliquot into aerated tubes at 30 °C in the dark. Analysis of cellular division, nuclear division (DAPI stain) changes in cell size, were performed. The proportion of mother cells and daughter cells were assessed at the end of the cell cycle. Toxicity of metal was assessed by algal growth inhibition test, estimating toxicity endpoints, growth rates, protein, antioxidant enzymes activities of catalase, guaiacol peroxidase, ascorbate peroxidase, glutathion reductase and concentration of chlorophyll a, chlorophyll b and carotenoids at the end of 96 hs of exposition. Nickel provoked a block of cell cycle at the highest concentration tested. At lower concentrations, cell cycle progression was observed with different pattern of attained CP, depending the exposure concentration. Antioxidant enzyme activities were inhibited at concentration above 0.05 and 1 mg/L. The effects of metal on pigment concentration was less evident than the effects on growth rates, indicating a lower sensitivity of these parameters. Nickel provoked severe damage on algal cell division and cycle progression kinetic parameters as well as modification of antioxidant enzymes activities. An integrated analysis is done discussing the consequences on population performance in natural environment after metal discharged from different anthropogenic sources.

TU019

Use of BioligEcoPlateTM to evaluate the effects of ZnO nanoparticles on soil microbial communities

V. Romano, Parthenope University of Napoli / Science and technology; v. pasquale, University Parthenope; s. schiavo, ENEA CR; M. Oliviero, s. dumontet, University Parthenope; s. manzo, ENEA / SSPT-PROTER-BES

Nanoagrochemicals seem to be the new frontier in modern agriculture due to their increased use efficacy, and to the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used as nanofertilizers as their nanoscale size provides a high surface area per weight. The use of metal NPs in agriculture might be explained by the release of nanoparticles, which can be distributed in the environment. The present study aimed to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on its biotransformation. ATU-treated sample was more diverse with a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protochlorambium increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

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was mainly affected by ZnO NPs. The integration of the classical ecotoxicology with BiologEcoplate approach could represent a good strategy to establish the environmental risk related to the use of nanofertilizers. Keywords: microbial community, ecotoxicology, nanofertilizers

TU020 Environmental factors-regulated disease dynamics of tilapia lake virus (Til.V) transmission in farmed tilapia ponds

T. Lu, Nation Taiwan University / Department of Bioenvironmental Systems Engineering; Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering; H. Lin, National Taiwan University; C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; W. Chen, Kaohsiung Medical University / Dept Biomedical Science and Environmental Biology; C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering

BACKGROUND: Outbreaks of tilapia lake virus (Til.V) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling Til.V disease dynamics should be clearly elucidated to prevent the potential economic impacts on aquaculture.

OBJECTIVE: The main objective of this study was to make the Til.V disease dynamics by constructing an epidemiological model to implicate aquaculture management among farmed tilapia ponds.

METHODS: The mortality of Nile tilapia infected by intraperitoneal (i.P.) injection with different Til.V dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50). To explain Til.V highly artificial environmental conditions, sacrificing some of the susceptible-infectious-mortality (SIM) model was applied to describe cumulative mortality data to estimate mortality rate (α), transmission rate (β), and basic reproductive number (R₀) for Nile tilapia posed by Til.V under treatment of cohabitation.

RESULTS: In toxicity assessment, LD50 estimate of Nile tilapia infected by i.P. injection with different Til.V dosage was 57127.5 TCID50 mL⁻¹ for all species except the cyanobacteria (Synechocystis sp). Metal toxicity on both metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted in Til.V highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoated CuO (CuSO₄ as ionic control) and TiO₂ NPs on two endpoints, biomass production and photosynthetic maximum quantum yield (Fv/Fm), in nutrient-adjusted natural water (ANW) and the OECD 201 standard medium, using four freshwater species from three major algal groups: green algae (Chlorellales), cyanobacteria (Cyanobacteria), and cyanobacteria (Synechocystis sp). Metal toxicity on both parameters at 72 h was reduced in ANW in all algal species except the cyanobacterium, presumably because of natural organic matter (NOM) binding to the NPs and solubilized iones. The biofilm-forming diatom was most resistant to NPs when incubated in ANW, whereas both the diatom and the cyanobacterium were not inhibited by TiO₂ at concentrations up to 100 mg/L throughout. TiO₂ significantly inhibited biomass production of both green algae in the standard medium (EC₅₀ 143-141 mg/L), but only R. subcapitata was inhibited in ANW (EC₅₀ 31 mg/L). TiO₂ NPs did not significantly inhibit Fv/Fm of any species in either medium up to 100 mg/L, indicating a lack of toxic effect on the photosynthetic apparatus. The sensitivity to CuO remained at a similar level in the standard OECD medium (biomass based EC₅₀ 0.2-0.9 mg/L) for all species, but differed over orders of magnitude in ANW (EC₅₀ 0.3-16 mg/L). The cyanobacterium, that has the smallest cell of the four tested species, was consistently most susceptible to Cu toxicity. While shedding of Cu ions from particles explained Cu toxicity, TiO₂ effects were at least in part due to observed cell monolayer heteroagglomeration. Overall, Fv/Fm was a less sensitive toxicity endpoint than biomass, but the two parameters were strongly correlated (Spearman’s ρ=0.6-0.9) when toxicity was evident, again proving Fv/Fm as a rapid method for toxicity detection. The observed discrepancies in toxicity indicate that using different model organisms, experimental endpoints and conditions could provide valuable information about the behavior of emerging contaminants in the environment, thus improving the quality of risk assessment. Research was funded by IUT23-5.

TU021 Natural organic matter alleviates TiO₂ and CuO nanoparticle toxicity in four algal species

E. Cappiello, V. Arujo, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology; K. Olli, University of Tartu / Institute of Ecology and Earth Sciences; A. Kahu, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology

Although the knowledge concerning synthetic metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted in Til.V highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoated CuO (CuSO₄ as ionic control) and TiO₂ NPs on two endpoints, biomass production and photosynthetic maximum quantum yield (Fv/Fm), in nutrient-adjusted natural water (ANW) and the OECD 201 standard medium, using four freshwater species from three major algal groups: green algae (Chlorellales), cyanobacteria (Cyanobacteria), and cyanobacteria (Synechocystis sp). Metal toxicity on both parameters at 72 h was reduced in ANW in all algal species except the cyanobacterium, presumably because of natural organic matter (NOM) binding to the NPs and solubilized iones. The biofilm-forming diatom was most resistant to NPs when incubated in ANW, whereas both the diatom and the cyanobacterium were not inhibited by TiO₂ at concentrations up to 100 mg/L throughout. TiO₂ significantly inhibited biomass production of both green algae in the standard medium (EC₅₀ 143-141 mg/L), but only R. subcapitata was inhibited in ANW (EC₅₀ 31 mg/L). TiO₂ NPs did not significantly inhibit Fv/Fm of any species in either medium up to 100 mg/L, indicating a lack of toxic effect on the photosynthetic apparatus. The sensitivity to CuO remained at a similar level in the standard OECD medium (biomass based EC₅₀ 0.2-0.9 mg/L) for all species, but differed over orders of magnitude in ANW (EC₅₀ 0.3-16 mg/L). The cyanobacterium, that has the smallest cell of the four tested species, was consistently most susceptible to Cu toxicity. While shedding of Cu ions from particles explained Cu toxicity, TiO₂ effects were at least in part due to observed cell monolayer heteroagglomeration. Overall, Fv/Fm was a less sensitive toxicity endpoint than biomass, but the two parameters were strongly correlated (Spearman’s ρ=0.6-0.9) when toxicity was evident, again proving Fv/Fm as a rapid method for toxicity detection. The observed discrepancies in toxicity indicate that using different model organisms, experimental endpoints and conditions could provide valuable information about the behavior of emerging contaminants in the environment, thus improving the quality of risk assessment. Research was funded by IUT23-5.

TU023 Impact of the antimistamine fexofenadine on structure and functioning of leech-associated microbial communities

P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J. P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; J. Fahml, T. Brödin, J. Klaminder, Umea University / Department of Ecology and Environmental Science; M. Bendschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment Effect of modern pharmaceuticals not designed to control microorganisms (e., antibiotics and fungicides) on aquatic microbially decomposers and the functions they provide are rather well-documented, while knowledge about effects of other micropollutants is scarce. In a recent study the antihistamine fexofenadine was shown to impact the microbial decomposition of plant detritus, however, the mechanism basis for this remains unexplored. We therefore conducted a microcosm experiment, where we microbially colonized two plant substrates (i.e., black alder leaves and hay). Both precolonized substrates were subsequently exposed towards fexofenadine at concentrations of 0, 2, and 200 μg/L. Replicates (n=10-15) were harvested after 15 and 30 days. Substrates were used to determine mass loss or preserved to estimate microbial communities’ structural or functional composition including fungal biomass, sporulation of aquatic fungi, bacterial abundances, bacterial and fungal enzymes, and bacterial fatty acids. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to analyze total organic carbon. After 15 days of exposure, there was a tendency towards reduced decomposition of black alder leaves (~40%) in both fexofenadine treatments, while after 30 days, decomposition in the 200-μg/L treatment was increased by ~45% (but both not significantly different from the control). On the contrary, the decomposition of hay tended to be increased by fexofenadine exposure after 15 days. After 30 days no differences could be observed among fexofenadine treatments for hay, while generally more hay was decomposed than black alder. Accordingly, in water samples of the two substrates, substantial differences in the DOC quality were observed. Furthermore, fexofenadine exposure led to changes in enzyme activity and ratios to an increased proportion of microbially-derived DOC. These observations suggest that the microbial communities’ structure and/or functional composition differ between the two tested substrates as well as among the antihistamine treatments. Moreover, potential implications in carbon and nutrient fluxes in exposed systems are indicated as the detected alterations in DOC quality may affect planktonic decomposer communities that are involved in DOC’s degradation in surface waters. To gain an in-depth mechanistic understanding of the observed effects, we are currently analyzing variables related to microbial community structure and functioning.

TU024 Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project INTCATCH

M.D. Scrimshaw, Brunel University / Institute for the Environment; S. Marcheggiani, Italian Institute of Health ISS; O. Tcheremenskaia, Italian Institute of Health ISS / Environment Health; M. Carere, Italian Institute of Health ISS / Environment Health; P. Tcheremenskaia, Italian Institute of Health ISS / Environment Health; L. Bacteria able to metabolize such toxic substances are indeed well known as well as many of their metabolic pathways, but still an efficient and complete detoxification process is hard to achieve. The understanding of the microbial activity underpinning the whole process is crucial especially during a bioremediation process where microbes are stimulated through the amendment of nutrients in order to obtain the complete detoxification. The huge impact of metagenomics, and other molecular biology techniques for the comprehension of microbial composition and activities in different environments, is helping to shed light for the comprehension of the critical apparatus behind the detoxification process but we are still at the beginning. During the present work, two microbial populations inhabiting a chlorinated solvent polluted groundwater, with and without nutrient amendment, have been analyzed after whole genomic DNA extraction and sequencing. The data analysis, together with the chemical ones, will help to enlighten the differences between the two populations in terms of genes expression and potential of biochemical pathways for pollutants’ biodegradation in relation to the chemical and geochemical parameter characterizing the specific site. Metagenomics of polluted sites is a powerful tool that could help in the future to define the best strategy to employ in order to obtain a complete environmental detoxification. This approach will be useful both for companies operating in soil and water recovery and for policy makers.
Microbial communities provide a large range of ecosystem services such as primary organisation, and more intricate risks on ecosystem structure and function. Assessing the impacts of chemicals still largely relies on approaches that are based on specific negative effects on ecosystems, it is essential to consider higher levels of ecological assessment. In this presentation we will describe the challenges within both aquatic and terrestrial microbial community ecotoxicology. Finally we will discuss future research directions in microbial community ecotoxicology to accurately assess and predict impacts of chemicals on ecosystems, and to develop specific response indicators of chemical exposure and effects.

**TU027 Hydrodynamic conditions alter the tolerance of biofilm communities towards chemical stress**

B. H. Polst, Helmholz Centre for Environmental Research - UFZ / Department of Bioanalytical Ecotoxicology, F. Larra, Helmholz Centre for Environmental Research - UFZ GmbH; S. Lips, Helmholz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology, C. Anlanger, U. Risse-Buhl, M. Weitere, Helmholz Centre for Environmental Research UFZ / Department of River Ecology; M. Schmitt-Janssen, UFZ - Helmholtz Cite Environm. Research / Department of Bioanalytical Ecotoxicology

Biofilms in rivers are complex communities built of bacteria, fungi, algae and protozoa embedded in a matrix of extracellular polymeric substances (EPS). They are important hotspots for biogeochemical processes in aquatic systems. A variety of stressors can potentially affect the structure and function of biofilms. Therefore their tolerance to one stressor may be influenced by former exposures to another stressor. Community composition and physical structure is influenced by hydraulic conditions. Even though the relationship between EPS and hydraulics is not fully understood to decrease with higher mean flow velocity and turbulence, the cell-to-EPS ratio increased. As the EPS content of a biofilm may influence the bioavailability of toxicants, differences in community tolerance towards herbicides are expected for biofilms grown under variable flow conditions. Still, the interactive effects of hydraulic growth conditions and herbicide tolerance are lacking. Using an artificial flow-through channel and water from the River Selke (Elbe catchment, Germany), we created heterogeneous flow regimes and related biofilm community structure and function to different mean flow velocities and values of turbulent kinetic energy. Taking the biofilms grown under such controlled hydraulic conditions, herbicide tolerance towards prometryn was tested according to the OECD method. Focusing on the putative aquatic pathogenic hyphomycete communities, we 1) investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photosynthesis) and 2) assessed the role of EPS in stressor interactions. The relevance of EPS content in combined stressor interactions was confirmed by using artificial EPS and algal cultures.

**TU028 Does fungicide exposure alter interspecies relationships of aquatic fungi during leaf decomposition? - A case study using species-specific qPCR assays**

N. Roedig, University of Koblenz-Landau; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J.P. Zubrod, D. Englert, N. Roedig, University of Koblenz-Landau / Institute for Environmental Sciences; M. Kosekhowak, University Koblenz-Landau / Institute for Environmental Sciences; C. Spens, University of Koblenz-Landau / Institute for Environmental Sciences; C. Baschien, Leibniz Institute DSMZ - German Collection of Microorganisms and Cell Cultures; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Lundskov, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Aqueous hyphomycetes, a polyphyletic group of freshwater fungi, are considered key players in leaf litter breakdown, an important ecosystem function in aquatic systems. Structural implications of anthropogenic stressors in aquatic hyphomycete communities have mainly been analysed using spore morphology, which does not allow assessing direct influences on species-specific abundance and performance under stress. Therefore, we performed a microcosm experiment in which we related the fungal community development to the a) model fungal community approach: leaf decomposition to individual species’ abundances quantified via species-specific quantitative real-time polymerase chain reaction (qPCR) assays. Using a factorial design, every possible single, binary and quaternary species combination of four different aquatic hyphomycete species (A. acuminata, H. subellata, N. lugardensis and T. marshallianum), was exposed to the model fungal community treatment. A mixture composed of four substances with different modes of toxic action (four sum concentrations ranging from 5 to 2500 μg/L and a fungicide-free control; n=5, N=275). In monocultures, aquatic hyphomycetes exhibited different fungicide tolerance levels, with concentrations ranging from 500 to 2500 μg/L resulting in significantly reduced abundances. Interestingly, only the two tolerant species (i.e., N. lugardensis and T. marshallianum) were capable of decomposing leaf material to a significant degree. Moreover, abundances of single species within the model communities as well as their functioning were governed by dominance interactions (e.g., one species outcompeting the other), probably as a result of competition for leaf substrate. Despite the species composition interactions,
resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species where generally those identified as tolerant towards fungicide exposure. However, qPCR results revealed that one of the two sensitive species exhibited a significantly increased DNA yield in presence of the other one at field-relevant fungicide concentrations (5 µL/L). Species-specific qPCR assays proved to be a valuable tool for assessing ecotoxicological effects on well-defined ecotaxonomic interactions within aquaculture hampers. In the future, this technique might become an asset in aquatic risk assessment and environmental stress monitoring.

TU029  
**Cyanobacterial Bloom in the Lake Varese: Characterisation of Microbial Communities by Metagenomics analysis**

D. Conduto Antonio, European Commission Joint Research Centre / Directorate Space, Security and Migration; R. Loos, I. Sanseverino, European Commission Joint Research Centre; A. Lahm, Bioinformatic consultant; A. Beghi, F. Pandolfi, ARPA Agenzie Regionale per la Protezione dell’Ambiente della Lombardia; P. Genoni, Lombardy Regional Environmental Protection Agency; D. Napieriska, T. Lettinger, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

The increasing anthropogenic eutrophication and climate changes are contributing to the intense proliferation of cyanobacteria in waterbodies so causing a phenomenon known as bloom which may compromise the quality of drinking and recreational water. The dynamics of bloom events are not yet fully understood, however it is scientifically accepted that external factors such as water temperature, nutrient concentrations and light intensity, may influence the potential of a bloom. Our study focuses on the relationship between environmental factors and the composition of the microbial community of the lake Varese (Italy) for a period of several weeks before and after the bloom event. Sampling campaigns were performed on a weekly basis. Water samples were collected from the depht region of lake Varese (3 m from surface and 2 m from surface depth) 13 n (MESO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCCHI). The samples were characterized for their chlorophyll a content, nutrients, cyanatoxons and genomic DNA was extracted for metagenomics. Purified DNA samples were subjected to 16S sequencing (variable region V3-V4) and for shotgun analysis. All 16S samples were MiSeq sequenced as 2x250bp paired reads, the corresponding shotgun samples as 100bp paired reads. Shotgun analysis was performed for sample collected from 31/8/2016 until 5/10/2016 and only for CPI and 2.5x SECCCHI. The results showed that a peak of cyanobacteria was observed around 14/9/21.9 in the SECCCHI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the 13 n (MESO) samples. Community composition of the overalying microbial community was also observed for protoctists and actinobacteria. Our results suggest that the major differences in bacterial community composition during the bloom are concentrated in the SECCCHI depth region while composition of the EPI zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom. This hypothesis is also supported by the cyanotoxin data although complementary 18S metagenomics sequencing would be recommended in order to discard a possible contribution of phototrophic eukaryotes.

TU030  
**Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope**

D. Hach, Institute of Aquatic Microbial Ecosystems, Ecologie et Pollutions (MAEP); J. Gahou, Irstea Lyon-Villeurbanne; m. masson, c. brosses, Irstea Lyon; B. Volat, Irstea Lyon-Villeurbanne; C. Bonmineau, Irstea Lyon; S. Pesce, Irstea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; M. Coquery, Irstea Centre de Lyon - Villeurbanne / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP)

In small streams, microbial communities form river biofilms attached to solid substrates by producing extracellular polymeric substances (EPS). This matrix may act as a protective layer by limiting cellular contact with surface water contaminants. Thus, several studies have suggested that during biofilm growth, biofilm and EPS matrix thickness could limit cellular bioaccumulation. To test this hypothesis, we conducted an experiment in which glass slides were immerged in a pond in Cestas (near Bordeaux, France) for one month to be colonised by periphyton. They were distributed in 3 aquaria containing a synthetic culture medium (Dauta, 1982) and effective concentrations of copper. The experiment showed that copper bioaccumulation is not significantly affected by Zr exposure as dominant species (2.5x SECCHI). The growing world demand for metals increases metallic element mobilization in aquatic systems. Although the effect of metals on freshwater ecosystems is well documented, studies on the impacts of tetravalent metals are very scarce. Zirconium (Zr) is a tetravalent non-radioactive element for which the global demand is increasing in the last decades. Benthic microorganisms (community perfomance) have shown good potential as a bionmonitoring tool to assess metal exposure of aquatic organisms. In this work, the effect of Zr on periphyton biodiversity and biochemistry was investigated to apply this tool to zirconium and other tetravalent metals contamination assessment and to better understand their potential impacts on aquatic ecosystems. Glass slides were immerged in a pond in Cestas (near Bordeaux, France) for one month to be colonised by periphyton. They were distributed in 3 aquaria containing a synthetic culture medium (Dauta, 1982) and effective concentrations of copper. The experiment showed that copper bioaccumulation is not significantly affected by Zr exposure as dominant species. Zr exposure effects were observed on biomass, proteins, polysaccharides contents but their productions appeared to be slightly lower in C1 and C2 at t2 and t4. Diatoms growth rate in the C2 condition was significantly lower than in C0 and C1. Results obtained by pigments fluorescence measurements showed significant cyanobacteria decrease in the C2 condition over the exposure time as well as the brown alage between t2 and t4. Principal response curve (PRC) analysis showed significant changes over time of microcmeofauna composition between the reference (C0) and the C2 condition. Giliates were less impacted by Zr exposure than flagellates which tended to disappear in the C2 condition. Biofilm microorganisms play a wide role in major ecosystem processes. Regarding these results, Zr exposure can impact the periphyton microorganisms composition which could disturb periphyton key functions. A better understanding of effects of metals on microcmeofauna would improve risk assessment of metallic exposure in aquatic ecosystems.

TU032  
**DNA metabarcoding demonstrates effects from copper at environmental concentrations on microbial diversity in marine periphyton biofilms**

N. Curcelli, University of Gothenburg, Sweden / Biological and Environmental Sciences; J. Yang, Nanjing University; State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; H. Kronenberg, T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; X. Zhang, Wisconsin Department of Natural Resources / State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; M. Eriksson, Chalmers University of Technology / Department of Shipping and Marine Technology

Copper pollution is common in coastal areas. In particular, the use of copper-based antifouling paints on ships hulls elevates copper concentrations in these environments. This study assesses the effects of dissolved copper on community structure and function of marine periphyton biofilms. Microbial diversity and community composition were assessed using high-throughput 16S and 18S rDNA sequencing, targeting prokaryotic and eukaryotic organisms, respectively. Community functional status was studied as impacts on algal biomass, photosynthetic pigment profiles and primary production. Additionally, we studied Pollution-Induced Community Tolerance (PITC) using photosynthesis as the endpoint. Periphyton was exposed for 18 days to five copper concentrations, between 0.01 and 10 µM, in a semi-static test. The resulting sequencing yielded 7.1 and 5.7 million high quality 16S and 18S reads, and the average numbers of 16S and 18S Operational Taxonomic Units among the samples were 9405 and 1242, respectively. Analysis of Unifrac distances showed that copper significantly changed the eukaryotic community structure at concentrations as low as 0.01 µM. The prokaryotic community structure was changed at slightly higher concentrations (0.06 µM). A total of 23 taxa, including species within the Proctobacteria_Bacteroidetes, Strunenoptics and Hacorobia classes, were identified as particularly sensitive to copper. Algal biomass, photosynthetic pigment profiles and primary production, were reduced at Cu concentrations of 0.06 µM and higher. PITC measurements confirmed that copper
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU/033
A Time-series Study of Soil Microbial Community Composition and Fattening Shift in Biodiesel vs. Petrodiesel Contaminated Soils
D.L. Carr, Texas Tech University / Biological Sciences; M. Dong, Texas Tech University / Biological Science
The spill of petrodiesel on land can irreversibly damage the soil ecosystem, and there are limited studies comparing petrodiesel and biodiesel impacts on soil microbial communities. Biodiesel has been considered as a viable substitute for petroleum, however it is unclear whether biodiesel is more microbial friendly than petrodiesel is inconclusive. Previous studies of soil microbial community on contaminated sites failed to reveal the dynamic changes of soil microbial communities. This laboratory study compared the effects of petrodiesel and three types of biodiesel on soil microbial communities in sandy loam soils. Contaminated soil samples were investigated at day 0, day 7 and day 180 to evaluate their effects on the composition and function of soil microbial communities. Biolog EcoPlates™ were used to test the microbial community functions based on carbon utilization while soil microbial composition were addressed by 16s rRNA gene sequencing of V3-V4 regions. Results suggested that biodiesels were not statistically different from petrodiesel in terms of their adverse impacts on soil microbial communities. In conclusion, our results suggested that biodiesels should not be automatically considered under different pedo-climatic conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by ICP-MS or MS or ICP-MS, PCA. ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green algae was sensitive to alkalinity, SO\textsubscript{4}, O\textsubscript{2} and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green algae responded positively to the metals Co and Ni and negatively to \textit{S}-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbamazepine/ibersartan/valsartan induced growth stimulation of \textit{N. palea} and \textit{N. pelliculosa} by an automated fluorometric microplate assay to evaluate the groundwater and river quality in four riparian wetlands in the south-west of Europe (Monbèqui (France), Saragossa (Spain), Bidasoa (Spain) and Toleda (Italy)). Four campaigns of water sampling were realized during contrasting hydrological conditions under different pedo-climatic conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS, PCA. ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green algae was sensitive to alkalinity, SO\textsubscript{4}, O\textsubscript{2} and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green algae responded positively to the metals Co and Ni and negatively to \textit{S}-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbamazepine/ibersartan/valsartan induced growth stimulation of \textit{N. palea} and \textit{N. pelliculosa}, respectively. Same records for pharmaceuticals were observed for the other three sites, excepted Bidasoa. Both extensive sampling and data analysis makes our approach a new useful bio-indicator for preliminary investigation of groundwater quality in order to predict the best location of quality water for human consumption (ATTENAGUA project).

Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment? (P)

TU/035
Can post mortem data be used to monitor population health in response in the barn owl? (P)
L. Walker, Centre for Ecology & Hydrology; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shaw, Centre for Ecology & Hydrology (NERC)
The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.ac.uk/) is national long-term project that monitors contaminant residues in a range of avian predator species. Each bird that is submitted to the scheme is given a post-mortem examination during which approximately 60 macroscopic observations and measurements are made. The information gathered during this examination could potentially be used to monitor health status of the birds at the time of their death or at a particular stage of their development. Previously we have focused on examining health indicators for the sparrowhawk, Accipiter nisus. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by fluctuating asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38-59%, and so years in which the prediction interval was extended beyond this would indicate a shift in the reproductive biology of barn owls, or an effect of the year on first-year survival. The current results in other species, including the Puechvieille and M. galloprovincialis, showed that the sex ratio in barn owls and first-year birds could be considered collectively. For many indices females and males needed to be studied separately due to sexual dimorphism. Females had significantly heavier mean body weights than males (287g vs 258g) but there was extensive over lap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat deposits were 23-65% and 28-75% for females and males, respectively. The level of kurtosis within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.

TU/036
Identifying suitable marine biomonitor in South Africa: Mussels vs Whelks
J. Sparks, Cape Peninsula University of Technology / Conservation and marine sciences; W. Samuels, Cape Peninsula University of Technology / Department of Conservation and Marine Sciences
Over the last three decades there has been a significant decline in marine pollution monitoring-related studies in South Africa. Little research has been conducted to assess the prevalence of imposex in whelks and also very few studies have been conducted on comparisons between contaminants in different marine invertebrates at the same sites. The current study was conducted in July 2017 to compare metal bioaccumulation between mussels (Mytilus galloprovincialis) and whelks (B. lagenari) as well as measure imposex prevalence in B. lagenari at Bloubergstrand, Granger Bay and Green Point, Cape Town, South Africa. This was done in order to identify suitable bioindicators of toxicity by determining whether the mussels and whelks bioaccumulate metals in the same way and to assess imposex prevalence in whelks (as an indicator of tributyltin contamination). The concentrations of metals (Al, Cu, Zn, Fe, Cr, Mn, Co, Ni, Mg, Cd, Pb) were measured in intertidal sediment, M. galloprovincialis and B. lagenari and imposex prevalence recorded in B. lagenari. Results showed that the highest prevalence of imposex in whelks and metal concentrations were recorded Granger Bay, an area of high boating activity. The most important result was that the whelks had higher bioconcentrations of metals than the mussels at all sites. Identifying biomonitors should be linked to purpose of investigation before selection of species, and mussels have been considered ‘ideal’ biomonitor of contamination in South Africa. Given the ubiquitous distribution of B. lagenari along the South African coast, which is not the case for M. galloprovincialis which only occurs on the west and south west coast of the country, the proposal is made that B. lagenari could be considered as alternative bioindicators of contaminant concentrations in the region.

Recent developments in environmental risk assessment for polinators (P)

TU/038
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (Bombus terrestris)
J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinsson, University of Oslo / Department of Physics; K. Borge, Department of Biosciences, University of Oslo / Department of Physics; M. Grung, A. Nielsen, University of Oslo / Department of Bioscience
Bees are increasingly facing multiple and interacting threats. One of the threats that have received increased attention lately is neonicotinoids: a group of systemic neuro-active pesticides that disturb the transmission of signals in the insect’s nervous system. In just a few years neonicotinoids have become the most widely used insecticide in the world, and protect a variety of crops against invertebrate pest. Despite being used in relatively small quantities, several studies have shown sub-lethal effects of neonicotinoids on honeybees (Apis mellifera) and other bee species. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by fluctuating asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38-59%, and so years in which the prediction interval was extended beyond this would indicate a shift in the reproductive biology of barn owls, or an effect of the year on first-year survival. The current results in other species, including the Puechvieille and M. galloprovincialis, showed that the sex ratio in barn owls and first-year birds could be considered collectively. For many indices females and males needed to be studied separately due to sexual dimorphism. Females had significantly heavier mean body weights than males (287g vs 258g) but there was extensive over lap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat deposits were 23-65% and 28-75% for females and males, respectively. The level of kurtosis within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.
levels (1 mg/L and 10 mg/L) to distinctly higher levels (100 mg/L) in a chronic exposure regime, lasting for eight days. To assess whether imidacloprid influences learning, the bumblebees’ ability to discriminate between blue nectar-filled (rewarding) and yellow water-filled (non-rewarding) artificial flowers were tested systematically in a flying arena. The bumblebees were tracked by cameras, allowing for analysis of the flowers choices, locomotor activity and all the flowers visited during numerous, simultaneous foraging bouts. This study shows the successful application of a new method to track bumblebee behaviour. Further, the study shows that learning and locomotor activity are negatively affected, in a dose-dependent manner, when bumblebees are exposed to imidacloprid. Moreover, we show that field-realistic doses of imidacloprid have negative effects on bumblebees.

TU039
Sensitivity of honeybee larvae to PPPs and impact analysis based on EFSA Bee GD *
R. Becker, BASF SE Agrarzentrum Limburgerhof; J. Lueckmann, Rifcon GmbH * on behalf of the ECPA NTA & Bee Working Group Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae or honeybee brood. In July 2013 the European Food Safety Authority (EFSA) published a guidance document on the risk assessment of plant protection products on bees (EFSA 2013). This document is intended to provide guidance for notifier and authorities in the context of the review of plant protection products (PPPs) and their active substances under Regulation (EC) 1107/2009 (EC 2009). The aim of this poster is to discuss the available industry data, for active substances and formulated products on honey bee larva testing according to e.g. OECD 237 and OECD 239, in order to gain an overview of these results and the selectivity of different product groups. As a first step in the risk assessment, EFSA requires a screening step which consists of the calculation of risk quotients (RQs) for honey bee larvae. This considers exposure routes for the active substances and formulated products (PPPs) applied as seed treatments and granules (on the ground and off-field (PPPs) applied as granules) and consequently impacts of pesticides on bumble bees (Bombus terrestris L.; Hymenoptera, Apidae) are commercially available and their biological, toxicological and environmental effects are well-known. However, the exposure analysis follows the principles described in the ECPA impact analysis (Miles and Alix 2013) and compared the first approach with the outcome based on laboratory data. In

TU040
Honeybee brood studies according to Oomen and OECD GD 75: Is there a difference of the brood termination rate under semi-field and field conditions*
J. Lueckmann, Rifcon GmbH; R. Becker, BASF SE Agrarzentrum Limburgerhof; S. Schmitzer, IBACON GmbH; B. Szczeniak, Eurofins Agroscience Services Ecotox GmbH
*on behalf of the ICP-PR Bee Brood Working Group and the Bee Brood Working Group of the German AG Bienenschutz Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae or honeybee brood. Regarding to the recommendation on the OECD risk assessment of plant protection products on bees (Apis mellifera, Bombus spp. and solitary bees) (EFSA 2014), both, the Oomen bee brood feeding test (Oomen et al., 1992) as well as the OECD Guidance Document 75 (2007; OECD GD 75) are given as the two higher tier options to refine the risk on honeybee brood if concern is raised in tier 1. Both methods focus on the brood termination rate (hereafter BTR) as the key endpoint. While the Oomen brood test investigates an artificial and worst case acute or chronic oral exposure scenario with a test item spiked feeding solution administered inside the hive (Lückmann & Schmitzer 2015) brood studies according to OECD GD 75 under semi-field conditions rely on a realistic contact and oral exposure scenario to bees comprising contaminated nectar and pollen after overwintering of a bee attractive crop. As the evaluation of historical data from semi-field studies according to OECD GD 75 showed a strong variability of the control BTRs (Becker et al., 2015), the performance of OECD GD 75 bee brood studies under field conditions was regarded as an option to get more reliable BTR data (Becker et. al. 2015, Giffard & Huart 2015). The present poster compares control BTRs from Oomen feeding studies with BTRs obtained from OECD 75 semi-field and field trials and considers explanations for observed variances. Moreover, the possibilities and limitations of the three methods will be discussed.

TU041
Does assessing of all brood cells of a hive reduce uncertainty and increase reliability of Semi-field honeybee brood studies (OECD GD 75)?
J. Lueckmann, J. Faupel, J. Ludwigs, Rifcon GmbH
According to EFSA (2013) bees semi-field and solitary bee studies have to be considered in addition to the assessment of honey bees in the risk assessments. However, suitable testing methods in the lab are currently partly available only (e.g. for acute contact & oral bumble bee testing, acute contact solitary testing) or under development (e.g. chronic oral bumble bee testing, acute oral solitary testing). Regarding appropriate species for solitary bee studies EFSA (2013) proposes Osmia cornuta or O. bicolor as test organisms for the risk assessment, and higher-tier semi-field testing with Osmia as proposed by the Plant Protection Regulation. A non-API threshold has been proposed for Osmia. However, experiences from current field studies on Osmia show that exposure of adults and larvae is not necessarily given as these solitary bee species have a pronounced polylectic feeding behaviour that can result into a low exposure to a test substance (i.e. not being a real worst-case). In order to address this problem, the refinement of worst-case solitary bee risk assessments under realistic field conditions may be achieved by using a 'focal species' concept, where most appropriate focal solitary bee species can be identified to represent a worst-case choice per crop, application time and country/zone. Whereas this approach is well-known for bird and mammal risk assessment it has not been yet applied for...
bees. Here, we present the idea of a ‘focal species’ concept for solitary bees, its needs, refinement options, advantages and limitations.

TU044
Non-Apis (Bombus terrestris) versus honeybee (Apis mellifera) acute oral and contact toxicity - Preliminary results of ECIP company data evaluation
A. Dinter, Crop Science, Bayer CropScience; W. Müller, Ingegneria Agraria; S. Schmitt, Analytica; L. Oger, Agroscope; A. A. Alix, Dow Agrosciences; Risk Management; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; P. Campbell, Syngenta / Environmental Safety; M. Miles, Bayer CropScience UK / Environmental Safety; E. Pilling, Dow Agrosciences / REGULATORY Sciences; N. Ruddle, Syngenta Ltd / Product Safety; A. Sharples, FMC Agricultural Solutions; G. Weyman, ADAMA; L. Kirchberger, ECPA

A preliminary data evaluation was conducted by ECIP companies to compare the sensitivity of bumblebees (Bombus terrestris) with the sensitivity of honeybees (Apis mellifera). For the evaluation about 70 data sets were available for contact exposure and about 50 data sets for oral exposure. The data sets comprised insectsicides, fungicides, herbicides in about equal numbers plus a few other substances. The preliminary data evaluation of LD50 values indicates lower or similar contact sensitivity of bumblebees vs. honeybees. Similarly, lower or similar oral sensitivity of bumblebees vs. honeybees was determined with one exception for an insecticide that indicated higher acute oral bumblebee sensitivity compared to honeybees. For this insecticide, higher tier data indicates no positive impact on bumblebees at the maximum intended use rate. Overall, a 10 EPICA company data evaluation indicates that bumblebees are not more sensitive than honeybees based on acute toxicity assessment.

TU045
Bumblebee (Bombus sp). 10 day feeding laboratory test design: First results from an ICP-PR ring test
N. Exeler, Bayer AG, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. Jenkins, Environ, H. Krueger, EAG Laboratories; A. Zicot, SynTech Research / ECOTOXICOLOGY; E. SOLER, TRIALCAMP SLU / ECOTOXICOLOGY; A. Molitor, Eurofins Agroscience Services GmbH; S. Vinall, Mambo-Tox Ltd; K. Amsel, BioChemagrar GmbH; S. Haupt, IBACON GmbH; S. Kimmel, Innovative Environmental Services (IES) Ltd / ECOTOXICOLOGY

A decline in some pollinator species has led to an increasing pressure on political decision makers and regulatory bodies and resulted in a changing of existing risk assessment paradigms and testing approaches. The published and already revised EFSA GD on the risk assessment of PPP on pollinators includes apart from the honeybee also bumblebees and solitary bees. In the need to address long term effects on bumblebees, the ICP-PR Non-Apis working group designed a ring test protocol to develop a first-tier chronic feeding test for bumblebees. Based on the recently published honey bee 10 day chronic feeding test guideline OECD 245 and the bumblebee acute oral toxicity test guideline OECD 247 a 10 day feeding test was set-up using dimethoate as reference substance. The response of adult Bombus spp. workers to the test chemical Dimethoate EC400 (Perfektion) was evaluated with three active ingredients and the toxic standard dimethoate. Bumblebees, honeybees and bumblebees show a declining bodyweight. Hence, the LD50 values after 96 hours ranging from 2.6 – 7.1 ug a.i/g bee indicate that a validated and workable methodology has been set up and a test guideline is within reach.

TU048
2 Years of Solitary Bee Semi-field Ring Testing and Final Conclusions (ICPPR Non-Apis Working Group)
S. Knaebel, EAS Ecotox GmbH / Ecotox Field; N. Exeler, Bayer AG, Crop Science Division; L. Franke, J. Fricke, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; M. Frommberger, Julius Kuehn Institut; T. Jütte, Julius Kuehn Institut; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology; O. Klein, Eurofins Agroscience Services Ecotox GmbH / Ecotox Field; J. Lueckmann, Rifcon GmbH; H. Giffard, Testapli; A. Rossbach, Tier3 Solutions GmbH / Field team; C.W. Schneider, BASF SE; A. Schnurr, BioChemagrar GmbH

The publication of the proposed EFSAs risk assessment guidance document of plant protection products for pollinators highlighted that there are no study designs for non-Apis pollinators available. Since no official guidelines exist for semi-field testing at present, a protocol was proposed and two years of ringtests were conducted in 2016 and 2017 to develop a general test set up. The ringtest design was based on the EFSA guidance document, OEP/EPPO Guideline No. 170 and results of discussions regarding testing solitary bees during the meetings of the ICPPR non-Apis working group in 2015, 2016 and 2017 followed by a workshop in 2017 to harmonise methodology. Ringtests were conducted with two representatives of a solitary bee species (Osmia bicornis and Osmia cornata) with the sensitivity of honeybees (Apis mellifera, but stingless bees present a very different behaviour and biology. The process orientation, the internal care of the hive, the feeding system, the nest building materials and the size of the hives are quite variable. However, there are no specific methods for toxicity tests to stingless bees. So, in our laboratory we are developing and standardizing methods to test the toxicity of pesticides to species of stingless bees. We test the Acute Contact Toxicity Test protocol of OECD guidelines (214) established to european honeybee for the stingless bees Scaptotrigona postica and Melipona scutellaris. For this, we use the ringtest standard design for insecticides. Toxicological tests were conducted in a 29 ± 2 °C incubator (29 ± 2 °C instead of 25 ± 2 °C), anesthesia should be done by cooling and the time should be adequate for each species. The development of these tests will allow the development of safer strategies for the protection of biodiversity and, at the same time, support the expansion of agriculture, which is an important socio-economic activity in the region.
termination rate during the larval development as well as the success of emergence of their progeny (F1-generation) in the following year. Based on the results of the ringtests over 2 years a draft protocol is available together with recommendations for the methodology needed. This includes how the cocoon incubation and hatching of bees can be synchronised with the onset of flowering, how fit solitary bees are out of season and which substance at what rate can be used as reference item for brood studies.

**TU049 Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach**

T. Pamminger, BASF SE, Agrarzentrum Limburgerhof / Ecotoxicology; N. Hoffmann, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; M. Bergtold, BASF SE

Plant protection products (PPP) play a vital role in modern agricultural practice. Nevertheless, their potential off-target effects on managed (e.g. Apis mellifera) as well as wild (most non-Apis species) bees have emerged as an intensively discussed topic. In current research, and especially with A. mellifera, it is clear that we need to cover potential adverse effects of PPPs on non-Apis bee species. However, as robust and scientifically sound information regarding the sensitivity of non-Apis bee species are scarce the validity of this approach has been challenged. As a first step to address this question we have compiled a comparative data set of the Acetylcholine Esterase (AChE) inhibitors sensitivities of 21 bee species, covering five of exposure to residues. Method furnished as data set was complemented with information on bee bodyweight, a trait likely influencing bee sensitivity to PPP exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to AChE inhibitors and confirms that A. mellifera is particular sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to AChE inhibitors, especially when controlling for body weight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

**TU050 New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experience**

M. Perssiezohl, Tier3 Solutions GmbH; U. Zumkier, Tier3 Solutions GmbH / Regulatory Science; A. Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH

With the growing concern for insect populations and an increased awareness of the importance of pollinators in the public opinion as well as in the regulatory context related to pesticides, there is a need to improve our methods for determining residues of residues as part of (semi-) field studies with bees in pollen, nectar and honey. The methods used need to adequately reflect the properties of the tested substance and the circumstances of the application as well as potential influences of behavioural aspects such as foraging behaviour. Also, residue kinetics of a given substance have to be considered and must be reflected in the time points used for sampling. Here, we present recently employed approaches for studies which measure exposure to residues. Method furnished as data set was complemented with information on bee bodyweight, a trait likely influencing bee sensitivity to PPP exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to AChE inhibitors and confirms that A. mellifera is particular sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to AChE inhibitors, especially when controlling for body weight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

**TU051 Normative Instruction 02/2017 - Brazilian risk assessment of pesticides to bees**

F. Viana, Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH

The Environment and Renewable Natural Resources (Ibama) is responsible for establishing policies for protecting pollinators. The Brazilian Institute for the Environment and Renewable Natural Resources (Ibama) is implementing the risk assessment of pesticides in Brazil and one of the main subtasks is the survey of potential bee risk from pesticide use. Ibama has taken multiple steps for this, including constant communication with beekeepers, the publication of world-wide surveys and the establishment of a database containing bee species in Brazil. In partnership with the German company Tier3 Solutions GmbH, Ibama published the first Brazilian specific regulation based on a risk approach, and in July 2017 Ibama established procedures to risk assessment of pesticides to pollinators. This is the first Brazilian specific regulation based on a risk approach, and in July 2017 Ibama published a Draft Regulation of Environmental Risk Assessment of Pesticides to Bees which explains in an accessible way how the normative should be applied. NI 02/2017 is widely based on US/Canada’s approach, which means that it focuses on Apis mellifera data; the models used for screening are Bee-REX and AgDrift; tests required for tier 1 are the same and there is one scheme for foliar applications and other for soil/seed/trunk treatments. But there are few modifications: 4 tiers, the last one being post-registration monitoring; use of a safety factor of 10 for non-Apis bees; residue trials must be performed in Brazil and for tier 2 a crop grouping is considered. With this normative Ibama expects that pesticides be used efficiently without incurring unacceptable risks to bees. Although Ibama has a full framework for risk assessment established for honeybees there are still gaps in knowledge and research needs for ensuring that procedures to protect bees can be improved, especially regarding native bees. Hence, a matrix of selection for Brazilian bee species was proposed for selecting native species for use in pesticide risk assessment. This matrix provided the basis for electing meliponines (stingless bees) as a priority group. In the near future Ibama intends to assess the need of changes in the risk assessment procedure, eventually including a stingless bee as a representative species.
for comparison with residue concentrations detected in pollen and nectar from treated and untreated crops. In 2016, a honey bee colony feeding study was conducted with thiamethoxam with the aim of providing a robust colony-level endpoint for comparison with residues in pollen and nectar. Analyses of the colony data indicate there were clear significant effects at the highest concentration of 100 µg/Kg for many colony parameters and overwintering survival. At 50 µg/Kg, despite a few treatment differences for pollen stores, overall colony strength and overwintering survival was superior to the control, conforming to the NOEL of 50 µg/Kg. The NOEL was determined to be 37.5 µg/Kg. To assess the potential risk to honey bees from exposure to thiamethoxam and metabolite CGA322704 (clothianidin) residues in pollen and nectar, the NOEL and NOAEL can be compared to measured residues in treated or untreated crops. In a treated oilseed rape-exposure study (Pilling et al., 2013) the maximum thiamethoxam residues found in pollen and nectar were 1.0 µg/Kg and 3.0 µg/Kg, respectively. The residues of CGA322704 were below the 1.0 µg/Kg LOQ. In an ongoing study, residues in pollen and nectar in untreated succeeding crops of sugar beet were also found to be low. The maximum thiamethoxam residues in pollen and nectar were 2.6 and 0.55 µg/Kg, respectively. A maximum CGA322704 residue of 6.3 µg/Kg was detected in pollen, while residues in nectar were less than the 1.0 µg/Kg LOQ. The colony NOEL and NOAEL concentrations are an order of magnitude greater than the maximum residues in succeeding crops and a treated crop. The colony NOEL and NOAEL provide the basis by which to evaluate the potential risk of thiamethoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of colonies to residues based on waggle dance observations analyses, harmonic radar or RFID chips. Most studies have been developed and tested to establish a kind of foraging maps, while the in-hive development of honeybees is relatively well understood and can be validated relatively easily in models, the accurate estimation of exposure is more complex and more difficult to validate. In particular, foraging behaviour, which is included explicitly only in very few models, plays an integral role for exposure, since it determines to what extent foragers collect nectar or pollen from treated or untreated crops and other habitats, or if they find alternative food sources. Foraging behaviour is also tightly related to weather. We therefore evaluate how foraging behaviour can be implemented and validated in a honey bee model simulating natural conditions, with particular focus on the risk assessment of pesticides and on the protection goals formulated in the recently published honeybee guidance.

TU056

Alteration of the alternative splicing pattern in honeybees' nervous system genes as a tool to test pesticides toxicity

P. Debsch, M. Soller, University of Birmingham

Evidence-based knowledge on pesticide-effects on pollinators, such as honeybees, has become mandatory in many countries. It is important to establish lines of action approved internationally to provide farmers and policy-makers more information about the applications of pest management programs. With this in mind, this work evaluated whether sublethal doses of the insecticide thiamethoxam, the fungicide carbendazim, and the herbicide glyphosate would be capable of altering the alternative splicing of Elav and Dscam, genes which encode proteins from mRNA by reverse transcription. Then, we performed PCR with γ-ATP radioactively labelled primer for Elav and Dscam. Because the PCR products have very similar sizes but differ in sequence, we digested the PCR products with restriction enzymes and then separated these fragments on denaturing polyacrylamide gels. It was not possible to observe a differentiated pattern of splicing for Elav neither for Dscam, comparing the control groups with the bees exposed to pesticides. The doses used and the exposure time in our study was not sufficient to indicate these genes as biomarkers in Apis mellifera. However, further studies are needed, exploring different doses, contamination routes, and increasing the exposure time to verify if these pesticides are capable of altering the alternative splicing pattern of genes directly related to the nervous system. (Faspes: 201522368-5).

TU057

Non-uniform distribution of treated sucrose solution via trophallaxis by honeybees affects variability of homing success rate, gene expression and mortality among replicates

L. Jeker, M. Wang, Swiss Bee Research Center / Agroscope; Y. Christen, University of Applied Sciences and Arts Northwestern Switzerland

We compared the impact of the feeding regime group dosing with 10 bees versus group dosing with two bees per cage on the variability of the homing success rate, gene expression and mortality. Based on our own observations and the recently published publication (Brodscneider, R., et al. 2017) it seems that food sharing via trophallaxis might lead to a non - uniform distribution of the tested sucrose solution between caged bees. This can cause high variability on measured parameters among group members, replicates and treatments. For homing success rate and gene expression endpoints, bees were orally exposed to different sub-lethal concentrations of thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/bees, based on the homing flight ring-test protocol. For mortality, bees were exposed orally to dimethoate at 0.033, 0.07, 0.1, 0.13, and 0.35 µg/bees, based on the acute oral toxicity test guideline OECD 213. For both methods, the treatment-feeding regime, was conducted with ten bees/cage and two bees/cage. Homing flight success rate, at 1ng TMX/bees, was significantly lower with ten bees compared to the two bees approach. A large variability of success rate and gene expression, during treatment runs, replicates and in the ten bees feeding group. Acute toxicity data with dimethoate showed that group feeding scheme with ten bees per cage resulted in higher mortality when compared to two bees (at same dosing levels). As consequence, the LD50 value is higher for the latter. High variability of homing success, gene expression or mortality rate in the ten bees feeding scheme is most likely caused by inhomogeneous dose distribution among bees, or either by over- or under dosing of single bees within replicates. A more accurate and uniform dosing distribution can be expected between 2 bees resulting in less variable data between runs, replicates and treatments. We highlight that feeding in smaller groups of honeybees should be discussed and considered to minimize the trophallaxis dependency regarding food distribution in group dosed honeybees. Moreover, to compare endpoints of toxicological studies with single dosed wild bees for regulatory purposes. (<b>clear</b> “all”) [1]<b>Brodschneider, R., Libor, A., Kulpiewieser, V., Crailsheim, K., 2017. Food consumption and food exchange of caged honey bees using a radioactive labelled sugar solution - PLOS ONE | https://doi.org/10.1371/journal.pone.0174684</b>

TU058

Modelling and validation of honeybee foraging behaviour for the pesticide risk assessment

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; C. Dietrich, WSC Scientific GmbH

In recent years a number of population models have been developed for honeybees and their uniforms have been used for pesticide risk assessment. While the in-hive development of honeybees is relatively well understood and can be validated relatively easily in models, the accurate estimation of exposure is more complex and more difficult to validate. In particular, foraging behaviour, which is included explicitly only in very few models, plays an integral role for exposure, since it determines to what extent foragers collect nectar or pollen from treated or untreated crops and other habitats, or if they find alternative food sources. Foraging behaviour is also tightly related to weather. We therefore evaluate how foraging behaviour can be implemented and validated in a honey bee model simulating natural conditions, with particular focus on the risk assessment of pesticides and on the protection goals formulated in the recently published honeybee guidance.

TU059

Automated waggle dance decoding

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; J. Kleinmann, A. Görlich, WSC Scientific GmbH

In honeybee field studies EFSA recommended in its latest guidance that field studies should ensure that the 90th percentile is met. Practically, it is challenging to confirm where honeybees actually foraged. In recent years a variety of methods have been developed and tested to establish a kind of foraging maps, based on waggle dance observations analyses, harmonic radar or RFID chips. Most of these, however, can realistically be used only based on relatively few individual bees. We therefore explored options for an automated analysis of waggle dance in honeybees. The system should facilitate the use of standard hives and should be usable without a computer in the field. We evaluate the reliability of the method.

TU060

How to increase test power and understand risk in refined honeybee trials


For honeybee semi-field and field studies EFSA defined SPGs (specific protection goals) in its latest guidance document on the risk assessment of plant protection products (PPP) on bees. Detrimental effects on colony size as a result of PPPs should not exceed a 7% threshold to not endanger the fulfillment of the ecosystem services provided by honeybees. The measurement of effects on colony size as small as 7% is often difficult to achieve due to high uncertainty and variability both reducing the test power. By applying a modified field methodology and test design the test power can be increased substantially thus allowing to conduct field studies that are able to reach the SPGs. For the semi-field study colonies with sister queens of equal strength were used. From these a subset of colonies was selected based on high foraging measurements, which started approximately four weeks prior to exposure, by selecting those colonies that would be similar during the exposure phase. During the whole study the colony strength was assessed by photographing all bees in hives (all frames and walls). Additionally, to include also the number of foragers in the assessment, hives were weighted with and without bees. To avoid an influence of the time of the day on the number of foragers counted with photography all colonies were photographed in a parallel at the same time of the day. All frames of all hives were also photographed to assess brood development and to obtain a full overview of the condition of each hive at each time point. It is shown that by applying a refined, new field methodology and test design for field studies on honeybees the
test power referring to the number of adults can be increased. Assessments of complete hives, including adults and all cells, make it possible to gain a detailed insight into the development of colonies and hive parameters over the course of time. Environmental factors and their influence on different hive parameters can be assessed and used to explain how these parameters either alone or in conjunction with plant protection products have an impact on the strength and development of honeybee colonies.

TU061 The potential for immune activation and possible consequences for bees upon exposure to microbial pest control agents

B. Jones, M. Whittaker, Applied Insect Science Ltd

Microbial pesticides are unlikely to cause disease in non-target insects due to a lack of specific pathogenicity. However, simply exposing the insect to a microbe has the potential to activate subclinical responses that can lead to colony level effects. For example, injection with a non-pathogenic, microbial immune elicitor induces a massive antimicrobial peptide response in bumblebees and honey bees. This immune response lasts several days and is costly to maintain. These costs are demonstrable through trade-offs between immunity and other life-history traits such as learning and longevity. In addition, immune activation alters many aspects of normal colony functioning, such as changes in foraging activity, decreased queen attendance, modified feeding behaviour, increased production of sexuals and forced ejection. Crucially, many of these effects only become apparent in the colony, and show specificity between bumblebees and honey bees. The established paradigm uses laboratory trials as a ‘worst-case’ scenario before progression to higher tier field trials, which may mask the downstream immunological impacts on endpoints such as longevity. Evidence exists for immune activation in insects via oral exposure with non-pathogenic bacteria. We therefore propose the need to establish whether oral and cuticular contact with microbial pesticides can induce the immune system in bees. Should immune activation be confirmed in the laboratory in the absence of lethal effects in higher tier field trials may be required to reveal the consequences within the colony.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (P)

TU062 Assessment of Levels of Some Heavy Metals in the Organs of West African Dwarf Goat and Beef Cattle in Ogbomoso, Nigeria

A.A. Giga, Cape Peninsula University of Technology / Department of Pure and Applied Chemistry; O.A. ADESOYE, Ladoke Akintola University of Technology Ogbomoso / Department of Pure and Applied Chemistry; F. Wewers, Cape Peninsula University of Technology / Chemistry

The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which ultimately make their passage into the tissue. This study aims at assessing the levels of five heavy metals (lead, cadmium, zinc, copper and iron) in organs of West African dwarf goat and beef cattle slaughtered in Ogbomoso metropolitan, Nigeria. Chevon and beef samples of heart, intestine, liver, muscle and tripe were collected from both sexes of the animals studied. The estimation of the non-essential metals in the investigated samples indicated the following range; lead: 1.11 - 6.00 mg/kg and Cadmium: 1.25 - 6.52 mg/kg while that of the essential metals are Zinc: 1.27 - 7.65 mg/kg, copper: 17.00 - 72.30 mg/kg and iron: 98.93 - 352.00 mg/kg. The results also revealed that the concentrations of lead, cadmium and Iron exceeded the stipulated permissible limits. Higher-than-allowance concentrations are observed in the various parts of cows than in bulls of the two cattle species. There was, however, no significant difference (p>0.05) in the amount of these metals accumulated by both the buck and Doe. There was a major reduction in the results obtained from the sampled samples when compared with raw samples for all the metals analysed. From the various data obtained, it can be concluded that all five metals are present in all the samples analyzed and their average concentrations are significantly high in most of the samples. Cooking lowered the amount of the potentially toxic metals in the meat samples.

TU063 Assessment of metal bioaccessibility, bioavailability and toxicity in soil using the earthworm

P.Y. Roubidoux, AGAT Laboratories, Ltd / Specialty services Division; Z. Omouri, INRS-Institut Armand-Frappier

Simultaneous contamination of ecosystems by various substances sets a challenge as regards to environmental assessment. One of the aspects is appraisal of pollutant bioavailability. Such an analysis was performed on a mixed contaminated site. The earthworm Eisenia andrei was exposed to different soils according to a contamination gradient. An integrated approach including a suite of biomarkers and chemical analyses was adopted to determine site toxicity. Parameters of the antioxidant system (catalase [CAT] and superoxide dismutase [SOD] activity), an enzyme of detoxification cation metabolism (glutathione S-transferase activity [GST]) as well as acid phosphatase (AP) activity and lysosomal membrane fragility of coelomocytes (neutral red retention activity, NRRT) were used as tools. Overall toxicity endpoints (lethality, body weight change, reproduction) were assessed. Lethal effects were detected in some soils whereas chronic endpoints significantly decreased. A significant response of time-growing extent and consistency was recorded for SOD from 2-28 weeks, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 28 weeks. A major peak was identified at 29.5 min, suggesting the potential induction of a biomolecule with lower molecular weight. Finally, regarding As, two major peaks were observed at 27 min indicating that Se was not bound to MT but rather to a biomolecule with higher molecular weight. In contrast, Bi was bound to MT and regulated in these fish by binding to MT. In conclusion, the results showed that the metals enter living organisms, they can penetrate into their cells and cause deleterious effects. Alternately, metals can be detoxified by binding to molecules designed to sequester them and prevent them from exerting their toxic effects, such as metallothioneins (MT) and metallothioneine-like peptides (MTLP). MT and MTLP are mainly found in blood and liver. MTLP can bind metals in the HSP fraction, generally obtained after homogenization, differential centrifugation and heat-denaturation steps. It is normally hypothesized that metals present in the HSP fraction are detoxified. To confirm this hypothesis, the nature of the metal-binding ligands found in the HSP fraction needs to be determined. Thus, the aim of this work was to investigate the ligands binding metals (As, Cd, Cu and Se) in the HSP fraction, in hepatopancreatic cells of the shrimp Litopenaeus stylirostris). In isolated, purified HSP fraction, generally obtained after homogenization, differential centrifugation and heat-denaturation steps, we identified that these two metals were reasonably well detoxified and regulated in these fish by binding to MT. For each metal, higher concentrations were measured in the HSP fraction of the exposed fish than in the control fish, but overall, metal-handling strategies did not vary between the reference and exposure fish, with the exception of As. For Cd and Cu, a major peak was observed after a retention time of 16 minutes, corresponding to the retention time of MT, suggesting that these two metals were reasonably well detoxified and regulated in these fish by binding to MT. In contrast, for Se, a major peak was observed at 27 min indicating that Se was not bound to MT but rather to a biomolecule with lower molecular weight. Finally, regarding As, two major peaks were observed in the reference fish (25 and 27.5 min), whereas in exposed fish a major peak was identified at 29.5 min, suggesting the potential induction of a specific ligand to bind As in exposed waste. For future work, the identification of the Se and As binding biomolecules would be of great interest to determine if these metals are detoxified or if, conversely, the biomolecules are metal-sensitive and their binding to Se or As represents a threat for the health of fish.

TU065 Assessment of Toxicological Impact of Anthropogenic activities on Onitsha stretch of River Niger in Northeastern Nigeria

A.C. Udebuani, Federal University of Technology / Department of Biotechnology; J.J. Nwajuba, Federal University of Technology Owerri / Department of Biotechnology; p. Abara, federal university of Technology Owerri / Biology The impact of anthropogenic activities on an urban stretch of a major river in Nigeria with respect to endocrine disrupting compounds and heavy metal concentrations was investigated. Three sampling points were selected along the Onitsha stretch of River Niger, based on the inlets of different tributaries into the river. Heavy metal contents of the water samples were analyzed after acid digestion, while the endocrine disrupting compounds were analyzed using liquid gas
chronomography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb>Hg>Cd>Cr>Ni. The HPI and MI values were far above the critical values. Results also showed EDCs obtained to include PAH, phthalates, PCBs, PCDDs, PBDEs, bisphenol A and PCBs. This study established that Onitsuka stretch of River Niger contains varying concentrations of heavy metals and EDs. The stretch of that river is highly polluted, and anthropogenic activities are highly impacting negatively on the river. Thus, there need to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

TU066 Comparing metallic elements in corals from South Africa and the Mascarene Basin

V. van der Schyff, North-West University / Unit for Environmental Sciences and Management; R. Choong Kwet Yive, University of Mauritius / Chemistry; H. Bouwman, North-West University / Unit for Environmental Science and Management

Coral reefs are one of the most bio-diverse biomes on earth. One of the many dangers that coral reefs face is the accumulation of metals and metalloids in their skeleton and tissues of the colonies. No knowledge exists on the state of metal and metalloid contamination in corals from the Western Indian Ocean (WIO). Fragments of four soft- and five hard coral genera were collected from five sites in the WIO. Sodwana and Aliwal Shoal constituted the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Mascarene basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected coastal sampling sites. Eighteen coral fragments were collected and analysed for 31 metallic elements using ICP-MS. The corals collected from South Africa contained a higher concentration of most of the metals that were analysed compared with the Mascarene Island samples. Corals without symbiotic algae could only be collected from the South African reefs, and contained the highest concentration of metalloids. Soft corals exhibited a different relative composition pattern of metals than hard corals. These been used to analyse as well as to determine differences between different organs of hard corals. Soft corals contained relatively higher concentrations of most of the post-transitional metals that were analysed. Sinularia is the coral genus with the most elements at the highest concentrations. Pocillopora from SBR had very high concentrations of Fe and Cr, possibly due to several shallow shipwrecks in the atoll. Most of the elements tested had lower concentrations in the WIO than in certain regions of the Great Barrier Reef and the Red Sea. Iron was consistently higher in all corals collected during this study than in corals from other studies. Some metals, such as Cu, Ni, and Cd, affect fertilization success of corals. Very high concentration of Ni was reported in Sinularia (1300 mg/kg dm) from Sodwana. As ocean temperature rises and ocean acidification increases, metals can become more bioavailable to corals, requiring further study.

TU067 Chronic toxicity assessment of Ni contaminated rivers in Japan using Ceriodaphnia dubia for development of biotic ligand model for Japanese surface waters

H. Watanabe, M. Noguchi, T. Misaki, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; N. Nakayama, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; M. Osada, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; S. Oda, National Institute for Environmental Studies / Center for Environmental Risk Research; K. Matsuoka, H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Risk Research

Ni is one of industrial essential chemicals and has been widely detected in Japanese river. US and EU have already established the water quality standard/criteria for aquatic life protection; however, it is still under development in Japan. In metal toxicity assessment, bioavailability of metals is an important factor and Ni bioavailability models (i.e. biotic ligand model (BLM)) for both acute and chronic toxicity have already been available for plant, invertebrates, and fish. They were developed respectively on the basis of the above data on the Japanese surface waters (hard water in general), which have different water chemistry from Japan (soft water, in general). Since water chemistry parameter (e.g. Ca, Mg, Na, K, pH, natural organic carbon) highly influence on metal toxicity, we should check applicability of the existing BLMs on Japanese surface waters or develop our own original model. The key factor is the development of standard/criteria for aquatic life protection and establishment of the water quality standard/criteria for aquatic life protection in Japan. In the present study, we used the Ceriodaphnia dubia, which is one of the most sensitive species to Ni and recently came into use as test species to evaluate surface waters and industrial effluent in Japan. We used the Windermere Humic Aqueous Model (WHAM) for speciation calculation. Ni toxicity was predicted using the existing chronic Ni bioavailability model for C. dubia established by De Schamphelaere et al. (2006). Except for uncontaminated upstream samples, the daphnids demonstrated typical toxic symptom of Ni (delayed lethal toxicity) and reproduction inhibition levels were correlated with Ni concentration suggesting that Ni is the representative toxicants in the collected samples. However, in several stations, other metals (such as Zn) may also contribute the toxicity thus we should carefully interpret the mixture toxicity.

TU068 Determination of the effects of platinum in the oyster (Crassostrea gigas) using cell and tissue level biomarkers

R. MEDRANO, University of the Basque Country; M. Abdou, UMR8505 EPOC / Geochemistry; M. Soto, University of the Basque Country / Zoology and Animal Infrastructure and Environment; A. Grobelak, M. Kacprzak, Czestochowa University of Technology / Institute of Environmental Geochemistry; S. Banaszak, M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering

Many anthropogenic activities have contributed to a release of contaminants, including heavy metals, into the environment. Since plants cannot leave polluted areas, it is, therefore, essential to possess a vast range of defence mechanisms that can reduce the toxic effects of heavy metals (HM). Contamination of soil and water with HM not only decreases the growth of plants but since metals can be accumulated in plant tissues they cause a severe threat to animals and humans the food chain. Identification of plants response mechanisms to contamination is becoming a prime objective in research since this knowledge can provide a solution for soil contamination and metal accumulation in plants. Studies on plants have demonstrated the ability of specific proteins - metallothioneins (MTs) to hyperaccumulate heavy metals, and play a significant role in their detoxification and overall oxidative stress. The physiological roles of MTs are not completely understood and much is still unknown concerning their characterization in many higher plants. The main objective of this study was to evaluate the effects of fertilization of contaminated with HM soil by sewage sludge on the genotoxicity levels and the expression of metallothioneins in plants shoots and roots. The toxicity assessment was conducted using selected measurement endpoints: germination index, roots length, the severity of DNA damage, chromosome aberrations and the expression level of metallothioneins. Sinapis alba L. was chosen as a model plant for this experiment. Plants were grown for 28 days in a growth chamber where they were exposed to soil contaminated by HM from metalurgical activities and to contaminated soil amended with different concentrations of sewage sludge. The study showed the effects of sewage sludge on the level of genotoxic effects caused by heavy metals as well as on MT expression. As such, a significant increase in the expression of metallothioneins was revealed in plants exposed to metal stress. Significant differences showed statistically significant changes between related conditions which means that presented assay can be used as a sensitive stress marker for phytoremediation process.
study the effects of culture medium on metal toxicity. Based on these results, our second purpose was to propose a new approach for the evaluation of metal toxicity on microalgae avoiding the interference of culture medium. In this study, we evaluated the toxicity of copper (Cu), lead (Pb) and zinc (Zn) on the microalgae *Pseudokirchneriella subcapitata*, since they are considered to be more sensitive to chemicals compared with other aquatic organisms such as fish. Cu and Zn were chosen as the study metal species due to their high ecological activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microplate (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (435/685 nm). In the first experiment, the microalgae was exposed for 72 hours to each metal using three different types of culture medium, OECD medium modified OECD (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalgae was exposed in a simplified test medium (destilled water buffered with MOPS and NaOH) only for 6 hours, as nutrients available for algae were limited. In the first experiment condition, the EC50 after 72 hours were 140, >1200 and 293 μg/L for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 μg/L respectively and in BBM, they were >300 μg/L in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 μg/L for Cu, Pb and Zn, respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affect the metal toxicity. Hence, we suggest that the simplified test medium may be an appropriate alternative to evaluate metal toxicity preventing interference of culture medium.

TU/01

Ecological Risk Assessment of Trace Metal Contaminated Tropical Estuarine Sediment, Southwest Nigeria

A. Usese, University of Lagos, Nigeria / Department of Marine Sciences; O.L. Chukwu, University of Lagos Nigeria / Marine Sciences; R. Naidu, The University of Manchester, UK / Global Centre for Environmental Remediation (GCER), Faculty Science and Information Technology; M.M. Rahman, The University of Newcastle / Global Centre for Environmental Remediation GCER, Faculty of Science; S. Islam, The University of Newcastle / Global Centre for Environmental Remediation Faculty of Science and Information Technology.; E.O. Oyewo, Nigerian Institute of Oceanography and Marine Research / Victoria Island, Lagos, Lagos, Nigeria / Department of Marine Science; T. Ofori, University of Lagos, Nigeria / Department of Marine Sciences; A. Yaro, University of Lagos, Nigeria / Department of Marine Sciences.

The study was carried out to evaluate the Tenango Dam water and tilapia (*Oreochromis niloticus*) in the Tenango dam, Puebla, Mexico. Tenango dam water and tilapia were evaluated to determine the effects of culture medium on metal toxicity. Based on these results, our

TU/02

Effects of culture medium on metal toxicity and new approach for ecotoxicology assessment

G. Pascual, Tohoku University / Civil and Environmental Engineering; I. Garcia, N. Torrecilla, O. Nishimura, Tohoku University / Architecture Civil and Environmental Engineering.

Pollution of aquatic ecosystems is a global problem affecting the biological continuity of living organisms. In this context, metals is a group of pollutants occurring naturally in the environment, however human activity increase its concentration in the environment. Therefore, for environment surveillance purposes, metals entering aquatic ecosystems are regulated by water quality guidelines. The last one is based on the results obtained in toxicity tests using aquatic organisms, nonetheless the reported medium Effective Concentration (EC50) of a tested metal in a species widely varies. Here, our first purpose was to...
Arsenic concentration range between (0.55–1.53 ± 0.26) mg/kg and chromium was (0.04-0.16 ±0.02) mg/kg. Cadmium and arsenic concentrations were below detectable limit of 0.001 mg/kg while mercury concentration ranges between 0.04-0.61 ± 0.01) mg/kg. Calculated target hazard quotient (THQ) was highest in mercury with the value of 560.59 and the lowest value was obtained in Arsenic with 1.43x10^{-4}. However, target cancer risk (TR) was highest for Lead with the value of 2.10x10^{-7} for cadmium, 5.1x10^{-4} for mercury, 2.8x10^{-5} for chromium and 0.84x10^{-4} for lead. This shows that the high toxicity of some heavy metals such as Lead, Arsenic, Chromium, Cadmium and Mercury and they have high cancer risk. Therefore, public health awareness on the risk associated with the use of these cosmetic samples should be carried out.

TU075 Fatty acid profile of Cerastoderma edule and Scrobicularia plana affected by copper sulphate exposure
Ad. Mesquita, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM, F. Gonçalves, University of Aveiro / Department of Biology and CESAM, J.C. Marques, University of Coimbra / Dept. of Life Sciences, Coimbra University; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biologia Departament & CESAM, Aveiro University
At the past 30 years were recorded an intensive practice in the use of fertilizers and pesticides, mainly in the European Mediterranean region, that, in particular cases, exceeded the limits of regular legislations established by the European Union. The widespread use of these chemicals, along with the pressure over agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper may affect biochemical processes, such lipid metabolism of some organisms, which may change the fatty acids composition of the two marine bivalve species Cerastoderma edule and Scrobicularia plana when exposed to copper sulphate, considering small (medium body size = 1.97 cm and 3.47 cm, respectively) and big (medium body size = 2.45 cm and 4.20 cm, respectively) size classes. In a first phase experiments were performed under laboratoral conditions to copper sulphate to determine lethal concentration; at a second phase, it was conducted, on the wild population of both nutritive species and size classes at the field and in the lab. Our results state C. edule is more sensitive to copper sulphate (LC50 = 0.818 (0.595–0.987) mg/L; 1.129 (0.968–1.289) mg/L, to big and small organisms, respectively) than S. plana (LC50 = 2.563 (2.229–2.903) mg/L; 4.705 (3.540–12.292) mg/L, to big and small organisms, respectively). Furthermore, the last one presents greater abundance and variety of FA and essential fatty acids (EFA), notably DHA and EPA, rates than C. edule. Still, big size class of both bivalve species is the most affected by the contaminant.

TU076 Heavy metals in soil and vegetables of allotment gardens in the Cape Town, South Africa
M. Mankenda, E. Wewers, T. Oosthuysen, T. Farrar, A. Giwa, Cape Peninsula University of Technology / Chemistry
Increased industrialization has resulted in an unprecedented dissemination of toxic substances, among which are heavy metals, in the environment. Heavy metals are persistent environmental contaminants which ultimately accumulates in soil with possible translocation into the tissue of vegetables, thereby posing a potential risk to human health. While most research focus on major agricultural areas, less attention has been paid to the accumulation of heavy metals in home gardens, schools and rural areas where subsistence farming is increasingly used in South Africa as a means of poverty alleviation and increasing food security. This study was conducted to investigate the concentration of selected heavy metals in soil, water and vegetables from allotment gardens in and around Cape Town, South Africa. Thereby assessing the health risk associated with the consumption of vegetables grown in the informal agricultural sector. Soil, water and vegetables were sampled during winter and summer seasons from the study areas and were analyzed for heavy metals (Pb, Cd, Mn, Zn, Cr, Cu, Ni, Fe and Co) using Inductively Coupled Plasma (ICP). Results showed that there are no significant seasonal or spatial differences in the physical properties of soil and water samples. The soil and water pH are slightly acidic, ranging from 6.30 to 6.90, and 5.60 to 7.00, respectively. Soil organic matter ranges from 1.7 to 13.5%. Results for water indicated that there was concentration fluctuation during winter and summer, with summer concentrations ranging from 0.062 to 0.947 mg/L, while in winter, the range was 0.002 to 2.347 mg/L. Soil heavy metal concentrations ranged from (0.59 –1209.95 mg/kg) in winter and (0.52 – 1127.41 mg/kg) in summer. For both seasons the metal concentration in soil increases in the order; Cd < Co < Ni < Cu < Cr < Zn < Mn < Fe. The concentrations of all the elements in soil and water samples were within the permissible limits set by WHO and FAO. The concentration of heavy metals in vegetables were generally higher in summer (ranging from (nd – 116.26 mg/kg) than in winter (ranging from (nd – 144.28 mg/kg), with the general trend being in the order; Cd < Ni < Pb < Co < Cu < Cr < Zn < Mn < Fe. In general, the below-ground vegetables such as brinjals and greens presented higher accumulation tendencies than above-ground and leafy vegetables such as cabbage and spinach.

TU077 High-selenium lentils offer a nutritional solution to combat arsenic poisoning in Bangladesh
J. Smits, University of Calgary / Ecosystem & Public Health Faculty of Veterinary Medicine; R. Krohn, University of Calgary / Dept. of Ecosystem & Public Health, Faculty of Veterinary Medicine; E. Akhtar, International Centre for Diarrheal Diseases, Bangladesh / Nutritional Biochemistry; B. Vandenberg, University of Saskatchewan / Plant Sciences; R. Raqib, International Centre for Diarrhoeal Diseases, Bangladesh / Nutritional Biochemistry
Background: Worldwide, the major chronic environmental threat to human health affecting over 100 million people, is daily exposure to naturally high levels of arsenic through drinking water and food, notably rice. Malnutrition increases the toxicity of arsenic. Low blood selenium specifically, increases the risk of arsenic-induced skin lesions and other manifestations of arsenic poisoning. Selenium, an essential element that interacts antagonistically with arsenic in the body, has been shown to decrease body burdens of arsenic and reduce arsenic-induced atherosclerosis in animals fed high selenium diets. Objectives: To reduce arsenic absorption, and therefore arsenic-associated toxicity in highly exposed people, through a dietary intervention with naturally high selenium lentils. This study is especially practical for populations already consuming lentils on a daily basis, as in the region notorious for chronic arsenic poisoning, the Indagoranic plains of northeast India and Bangladesh. Methods: For six months in a double-blind study, 400 participants with tube well As levels from 100 to 1200 ppb based on atomic absorption spectroscopy (AAS) analysis (WHO limits: 10 ppb for the west and 50 ppb in other regions) ate the same variety of lentils with high (0.854 ppm) or low (0.029 ppm) selenium because of the soil where they were grown. Urine, stool and hair samples were collected before, during, and at the end of the study, to determine arsenic levels and other physiological responses. Major outcomes: Mixed model statistical analyses determined that people consuming the high selenium lentils excreted significantly more arsenic though their urine (p<0.05) than those on the low selenium lentils, but there were no differences in stool As concentrations. Considering females only, there was a trend towards a difference in hair As on the 2 diets. Hair As decreased by 0.20 ppm in the high selenium lentil group, whereas it increased by 0.49 ppm in the low selenium group (p=0.07). Conclusion: This study indicates that selenium lentils offer a nutritional solution to combat arsenic poisoning in Bangladesh.

TU078 Metals removal from water for hazard classification
G. Cutright, University of Michigan / School for Environment and Sustainability; M. Hudson, University of Michigan / School of Natural Resources and Environment; R.F. Carbonaro, Mutch Associates, LLC / Civil and Environmental Engr; K.J. Rader, Mutch Associates, LLC; S. Baken, European Copper Institute; E.R. Garman, NiPERA / Ecotoxicologist
Metals usually enter aquatic ecosystems in anoxic environment and associated with particulate material. It is important for understanding the fate and partitioning of metals in aquatic environments and ecosystems. The bivalve species is a key consumer of metals and metalloids and plays an important role in the food web. It is important to understand this initial fate process in regards to toxicity and metal availability for other organisms in the food web. The removal of metals is commonly considered using the OECD method 29? What sediment characteristics affect metal removal and which do various test method conditions affect metal removal, using OECD method 29? What sediment characteristics affect metal removal and which show a reasonable worst case (RWC) condition? What is the mechanism for metal removal, and are metals released into overlying waters upon subsequent resuspension? Method parameters evaluated included: sediment type and loading rate, pH control, metal loading rate, pre-incubation of sediment, and resuspension. Sediment loading rates included dissolved Cu, Ni, and Fe, dissolved oxygen (DO), pH and AVS-SEM of sediments. Multiple dried vs. non-dried sediments were tested in batch reactors for both 96 h and 28 h tests. Dry Buffalo River sediment, a sediment with reasonable worst-case properties for metal binding, typically removed 70% Cu and Ni from the water column at 1 mg/L loading. Incubated sediments removed metals significantly faster than non-incubated sediments (p < 0.03). Higher sediment loading rates removed metals faster as expected. Sediment type and loading rates affected pH, which started at 6.0. Cu removal (96 h) and resuspension (1 h post 96 h) resulted in no significant increase in Cu, but did elevate Fe concentrations. The results show that 70% of Ni and Cu is removed from the water.
column using this test modified OECD 29 test method, using a variety of sediments and conditions.

**TU079** Modelling the chronic toxicity of copper to fish at low pH

S. Baken, European Copper Institute; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Bioavailability models account for the effects of water chemistry on metal toxicity to biota. They are a cornerstone of the environmental risk assessment of many trace metals, including copper. In this context, it has often been assumed that toxicity of dissolved copper to fish increases with decreasing pH. However, some studies show that this relationship may only be valid above pH 7. Below pH 7, the chronic toxicity of dissolved copper to fish seems to be independent of pH. Existing bioavailability models use the well-known mechanistic concept of the Biotic Ligand Model (BLM), but this modelling framework seems to have difficulties to reproduce the observed relationship of copper toxicity versus pH. This study was set up to refine the bioavailability models for chronic copper toxicity to fish, in order to better reflect the observed relationship between chronic copper toxicity and pH. The available chronic copper toxicity data to fish were re-reviewed. A new bioavailability model was developed using the concept of a generalized bioavailability model (gBAM). This semi-empirical model assumes a log-linear relationship between pH and effect concentrations (ECx) expressed as free cupric ion activity (Cu2+) and links it to the geochemical speciation model WHAM7 to predict toxicity on a dissolved copper basis. The existing bioavailability models were compared and contrasted to the newly developed gBAM. The underlying assumptions, advantages and limitations of each model are identified. Conclusions and implications for modelling copper bioavailability to fish are discussed.

**TU080** Novel In-situ Toxicity Assessment of Sediment Capping Effectiveness in Deep Water Environments

G. Burton, University of Michigan / School for Environment and Sustainability; M. Hudson, University of Michigan / School of Natural Resources and Environment; S. Nedrich, A. Rentschler, University of Michigan; K. Thiamkeelakul, University of Michigan School for Environment and Sustainability; S. S. Brown, The Dow Chemical Company / Environmental Remediation and Restoration

A former mining site has been the subject of intensive restoration for the past few years, with significant focus on disconnecting mine spoils from groundwater and managing the quantity and quality of runoff. A remaining task is to ensure that concentrations of zinc in surface water of a large pit lake are reduced below water quality standards. An investigation was conducted to compare the efficacy of sediment capping using 2D sub-grids for decreasing Zn dissolution during periods when the hypolimnion is anoxic and acidic (pH<5.5). Capping materials were selected based on results from laboratory batch testing and included AquaBlock, limestone, and limestone + bonechar. Experimental field tests implemented novel methodologies, using Limnocorals (LC) to isolate water columns above various capping treatments, simulating lake-mesocosms. Simultaneous in-situ and ex-situ toxicity tests were conducted using *Daphnia magna*, *Hyalella azteca* and *Chironomus dilutus*. Test organisms were protected from temperature shock by pre-acclimatizing over 24 hrs and then deploying the test chambers in a Toxicity Assessment Container System (TACS), which protected the organisms from warm surface waters until reaching the bottom sediments and colder water. Test organisms were exposed to surficial sediments in reference LC or capping materials and overlying water. In situ toxicity testing was conducted in waters and/or sediment cores collected from the bottom of each LC, and these tests were done at the same temperature as the in-situ TACS exposures (15 to 19°C, depending on deployment period). Results from in-situ testing demonstrated the usefulness of the TACS and provided similar results to the ex-situ testing. Preliminary results suggest organism survival is similar between in-situ capped and reference sediments; however, supplemental ex-situ analyses will help determine whether capping performance and toxicological response is indicative of site specific characteristics (sedimentation, sediment type, cap layer attenuation) and/or cap specific indices (permeability, adsorption, ion exchange capacity). Results provided for more effective decision-making, with reduced uncertainty, than standard laboratory and chemistry only approaches.

**TU081** REEchage - Rare Earth Elements Ecotoxicology in a Changing Environment

H. Tien, Hamburg University of Applied Sciences/University of the West of Scotland; C. Heise, Humboldt University of Applied Sciences / Life Sciences

REEchage focuses on the anthropogenic release of the rare earth elements (REE) lanthanum and gadolinium to the environment and their potential risk within ecosystems.REE are increasingly applied e.g. in green technology, and consequently also emitted to the environment. But there is a diversity of potential polluting sources of which little is known, and no regulatory environmental framework for immissions exists so far. In addition, a review by Herrmann et al. (2016) demonstrated the considerable lack of reliable data for La toxicity in the aquatic environment. Considering their future use, release, and environmental fate, an evaluation of environmental risk from lanthanum and gadolinium will have to be based on information on exposure pathways, exposure and effect concentrations. The project REEchage addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxicological responses obtained for *Alivibrio fisheri* and *Rhaphidocelus subcapitata* so far are in the same range as literature data, and show a higher toxicity of Gd compared to La. Effect concentrations are of the same magnitude as for cadmium. (2) by substance flow analysis (SFA) for La and Gd, exemplarily performed for Germany. Information has been collected from published work for a variety of potential sources for La and Gd in rivers and lakes. Additionally, water and sediment samples have been analysed at specific locations. Current data point to wastewater and specialised industries as prominent sources of emission. (3) by investigating the impact of changing environmental parameters (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests was applied to monitor the toxicity responses in overlying water and sediment. This includes tests with *Alivibrio fisheri*, *Vibrio proteolyticus* Arthrobacter globiformis and especially *Daphnia magna*. Additionally, speciation and bioavailability of the La and Gd are examined following a procedure by Simpson et al. (2014), applying a cascade of different filters and a chelating resin. The presented poster will depict the results of the microcosm experiments along with the information on bioavailability based on biotests and speciation data.

**TU082** Sediment characteristics of natural and anthropogenic origin and their possible association with benthic macroinvertebrates in a minimally affected river in South Africa

C. Wolmarans, H. Pienaar, G. Van Niekerk, NorthWest University School of Biological Sciences / Zoology

Sediment characteristics generally entail metals, minerals, organic content, elements, particle size, conductivity and pH. The origin of metals in sediment may originate from anthropogenic activities including mining, industries, agriculture as well as aerial deposition. Limited attention is however given to the contribution that natural occurring phenomena play in the concentration of metals in the sediment. Weathering of minerals originating from the primary lithology can on the one hand add to the metals in sediments and on the other hand to the particle size composition. Although it is well known that chemical pollutants, due to anthropogenic impacts, act as a major determinant for the macroinvertebrates composition in surface waters the influence of the above mentioned components in a pristine river is less known. The aim of this investigation was firstly to determine the sediment characteristics and secondly to establish which of these characteristics have a significant impact on the macroinvertebrate community structures in the Marico River, South Africa. South African rivers have a high variability of substratum at various sites, dried and sieved using an Endocott dry-sieving system to collect fractions < 2000µm and < 50µm. The total sediment samples >2000µm and clay fraction samples, 50µm were subjected to metal, scanning electron microscopy and minerals by X-ray diffraction analyses. Element anlyses were done by means of an FEI Quantas 230 FEG ESEM microscope equipped with an integrated Oxford Inca X-Max 20 EDS. Macroinvertebrates present in the benthos were collected by suction and sorted by size and taxonomy and studied using a stereomicroscope. Bioaccumulation and possible association with benthic macroinvertebrates were tested using *Daphnia magna* and *Hyalella azteca*. Test organisms were protected from temperature shock by acclimating the species under the same environmental conditions and then using a temperature, pH, and electrical conductivity testing system. Preliminary results suggest organism survival is similar between in-situ capped and reference sediments; however, supplemental ex-situ analyses will help determine whether capping performance and toxicological response is indicative of site specific characteristics (sedimentation, sediment type, cap layer attenuation) and/or cap specific indices (permeability, adsorption, ion exchange capacity). Results provided for more effective decision-making, with reduced uncertainty, than standard laboratory and chemistry only approaches.
through thioarbituric acid reactive substances (TBARS) measurement in the muscle tissue. The results showed changes in the behaviour and enzymatic activity at the different copper sulphate concentrations to both size classes. Moreover, according to TBARS levels, lipid peroxidation possibly occurred on the big size class of *C. edule*. The muscle tissue (foot) showed to be a good tissue to use in biochemical analysis to detect response to the exposure to toxicants.

**TU084**

The impact of single metals and mixtures in nature: a microcosm experiment

M. Van Ginneken, University of Antwerp, Dept. Biology / Biology (SPHERE); R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Even though ecological risks of metal-contaminated systems remains an important challenge, laboratory experiments with metal mixture exposure are receiving more attention in the literature, little research has examined the interaction of natural stressors with metal mixtures. In the lab, we already performed experiments on *Axelius aquaticus*, exposing this freshwater isopod to a combination of metal mixtures and temperature stress. This way we could study effects on the individual level and relate metal accumulation to relevant sublethal endpoints (e.g., growth rate, feeding rate). The present study, a microcosm experiment in a greenhouse, was designed to gain more insight into the effects of these metals on populations and communities. Small ecosystems with several species of macroinvertebrates were exposed to Cd, Cu, Pb and a mixture of these three metals under semi-natural conditions. In each bucket, we placed *Axelius aquaticus*, *Daphnia magna*, *Cryptocricus riparius* with different *Phytotelmata*, *Enchytraeus crypticus* (macrophytes) and *Raphidocelis subcapitata* (algae). The theoretical metal concentrations were 1.5 µg/L Cd, 70 µg/L Cu, and 72 µg/L Pb. Half of the medium was renewed weekly. The effects of the metal mixtures and natural stressors were examined after 4 and 8 weeks, on the individual level (total metal accumulation, survival, shoot and root length), the population level (species densities, biomass) and the community structure (diversity, evenness). Preliminary results show a high variability between replicates. We observed no significant differences in species densities between the metal treatments after 4 or 8 weeks. After 4 weeks, we found that Cu and the tertiary mixture negatively affected shoot and root length of *E. nutallii* compared to the control treatment. However, after 8 weeks, we did not find these significant differences. As we could not find any significant effects of the metals at the end of the experiment, further research focused on sublethal factors or with a longer exposure duration is needed.

**TU085**

The influence of soil properties on lead bioavailability and toxicity to *Enchytraeus crypticus*

L. Zhang, VU University Amsterdam / Animal Ecology; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Soil properties are important factors modifying metal bioavailability to soil organisms and subsequently affecting the metal toxicity. The present study aimed at investigating the bioavailability and toxicity of lead to the potworm *Enchytraeus crypticus* in soils with different properties. Soils with wide range of properties were spiked with Pb(NO₃)₂ at 9 concentrations of Pb to determine the effects of soil properties on Pb bioavailability and toxicity to *E. crypticus*. Survival and reproduction after 21 day exposure were related to total, 0.01 M CaCl₂ extractable and porewater Pb concentrations in the soil and internal Pb concentrations in the surviving animals. pHₕ₂O and pH_porewater decreased with increasing total Pb content for all soils, but pH decrease was much stronger for the soils with lower CEC and OC contents. Sorption of Pb from the CaCl₂ extracts could be well described by a Freundlich isotherm (R² = 0.96-0.99) and Freundlich sorption constant Kₘ increased linearly with increasing cation exchange capacity (CEC) (R² = 0.86) or organic carbon content (OC) (R² = 0.76). Pb bioaccumulation in the enchytraeid was soil-dependent, but differences between soils almost disappeared when relating Pb bioaccumulation to available Pb concentration in soils. Toxicity values varied greatly among soils, with median lethal concentrations (LC₅₀) based on total Pb concentrations ranging from 246 to 33902 mg Pb/kg dry soil. LC₅₀ on the basis of total Pb concentration increased linearly with increasing CEC (R² = 0.70-0.90) or pH_porewater (R² = 0.87-0.94). The differences in Pb toxicity among soils could be related to differences in CEC extracellular Pb concentrations in soil (R² = 0.97) and internal Pb concentrations (R² = 0.97). Median effective concentrations (EC₅₀) based on total Pb concentrations varied 12-fold among soils from 81 to 1008 mg Pb/kg dry soil. EC₅₀ on the basis of total Pb concentrations increased linearly with increasing pH_porewater (R² = 0.70-0.94). The variation in EC₅₀ was best explained by differences in the CaCl₂ extracellular Pb concentrations in the soils (R² = 0.94). In general, pH was an important soil property affecting LC₅₀, EC₅₀ and internal Pb concentrations in enchytraeids, as Pb availability, internal Pb, mortality and reproduction were inversely related to soil pH. Soil properties should be taken into account during the ecological risk assessment of metals in contaminated soils.

**TU086**

Toxicity evaluation of soils sampled in the vicinity of an Aluminum smelter in Montenegro using the Ames, Biotransformation and DR-LUC biosassays

A. Perovic, University of Montenegro, Faculty of Natural-sciences and Mathematics / Biology; S. Perovic, J. Vukic, University of Montenegro Faculty of Naturalsciences and Mathematics; D. Sukovic, Centar for Ecotoxicological Investigations; H.A. Leslie, Institute for Environmental Studies VU Amsterdam

This study conducted as a part of the national project ECOOTXI that main topic was testing applicability of several biosassays in assessment of cause-effect relation between levels of organic environmental pollutants in soils and its toxic and mutagenic response on samples organic extracts. Samples was collected in vicinity of Aluminum Plant Podgorica and pools of red sludge in Zeta plain. This area with intensive industrial activity is also reach with agriculture and is just in 5km distance from Podgorica (Capital of Montenegro). Waters of several rivers in this area, which are significantly influenced by municipal wastewaters of tree cities, are abundantly used for watering crops in area. We tested mutagenic potential of samples organic extracts in the Ames test, on bacterial strain *Salmonella typhimurium* TA98, acute toxicity on chironomus larvae *Vibrio fisheker* and concentrations of possible dioxins present in the samples by DR-Luc test on rat H4IE hepatoma cell line. The obtained results indicate a strong mutagenic effect of organic pollutants mixture in tree samples collected near the Aluminum Plant and pools of red sludge, what was significantly in correlation with the recorded concentrations of dioxins in the DR-Luc test and with measured concentrations of polycyclic aromatic hydrocarbons, which exist in the maximum allowable prescribed concentrations. Two of tree samples, with high response, were in agricultural area. Even if it is a clear trend of decrease of mutagenic effects as well as reduction of the concentration of dioxins and PAHs with increasing distance of sampling sites from the Aluminum Plant and pools of red sludge, almost all samples showed a certain elevated level of mutagenic activity, which may be a consequence of the impact of multiple sources.

Safe by Design: responsible and innovative research for safe and sustainable chemistry (P)

**TU087**

In silico approaches to screen and design safer chemicals

E. Papa, A. Sangion, P. Gramatica, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)

The prohibitive economic and social cost of testing, necessary to provide extensive information on fate and effects of existing chemicals to humans and the environment, highlights the need to focus on rational and safe design of chemicals before synthesis (i.e. Safe by Design – SbD approach). This approach applies the principle of green chemistry “Design safer chemicals and products,” and is useful to prevent hazardous substances from being developed and entering the environment, as well as to build safer alternatives to existing hazardous chemicals. While in the last decades computational chemistry and *in silico* models have been widely and successfully applied in the design of drugs with desirable pharmacological activity, these strategies have not yet been applied extensively in the design of sustainable, “safe by design” industrial chemicals as well as no real guidelines exist at the regulatory level. Modelling approaches based on Quantitative Structure-Activity Relationships (QSARs) rely on the assumption that biological activities/properties of chemicals are intrinsically dependent on the molecular structure. Endpoints like for instance toxicities, physico-chemical properties as well as biotic and abiotic degradations can be predicted starting from models based on molecular descriptors of the chemical structure, which serve as basis to develop the SbD approach. Therefore, in *silico* strategies such as the aforementioned QSAR (and QSAR-like) models and multivariate analysis (MVA) can be successfully applied to screen unordered properties of large sets of chemicals in order to identify potentially hazardous compounds or safer alternatives. In this poster we show different examples of QSAR models mainly implemented in the software QSARINS and available in the freely distributed QsarIns-Chem module to screen “safe” from “unsafe” compounds on the basis of different endpoints of scientific and regulatory interest. Different classes of emerging pollutants were investigated using *in silico* models, such as Flame Retardants (FR), Personal Care Products an Pharmaceuticals (PPCPs) and nanoparticles. All the presented strategies support the identification of safer alternatives to chemicals that are screened by QSAR as undesirable from their molecular structure. The QSAR approach, applied for SbD before the chemical synthesis, provides concrete opportunities to increase the sustainable use of chemicals and to reduce the need for a *posteriori* remedial actions.

**TU088**

Application of chemometric methods and QSAR models to support pesticide risk assessment starting form ecotoxicological databases

E. Galimberti, ICPS International Centre for Pesticides and Health Risk Assessment, Public Health and Natural Sciences; A. Moretto, Università degli Studi di Milano; E. Papa, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)

Recently the International Center for Pesticides and Health Risk Assessment (ICPS) of Milan-IT, together with the Wageningen University and Research Centre of Wageningen-NL, worked on a data collection project commissioned by the European Commission (EFSA). The aim of the project was to investigate the comparability of the EC₅₀ approach (Effect Concentration affecting a percentage x of test organisms) to the current NOEC approach (No Observed Effect
Concentration), both derived from chronic and long-term studies of a data sets of 70 active substances of plant protection products (PPPs). The new Regulation for the authorization of PPPs requires that ecotoxicological endpoint values, derived from chronic or long-term studies submitted by the Applicant, are reported as EC$_{50}$ or EC$_{20}$ as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depends on the experimental study design, whereas EC$_{x}$ values are considered more appropriate when they take into account the concentration-response curve. Ecotoxicological data gathered from 70 active substances' approval dossiers were collected and stored into a database, and then analyzed to derive NOEC. Adequate statistical models were selected and used to calculate EC$_{50}$, EC$_{20}$, and EC$_{x}$ with confidence intervals. In the present work, quantitative methods and models based on Structure-Activity Relationships (i.e. QSARs) were used to validate the Effect Concentrations of the active substances of the selected pesticides, and to predict missing data. The whole approach is mainly oriented to the aquatic environment, and can provide useful information to screen the potential undesired toxic effects of new pesticides, and of alternatives to existing active substances, starting just from the chemical structure. 

TU089 Influence of coatings in the bioaccumulation of TiO$_2$ and CeO$_2$ nanoparticles in rainbow trout

M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment; I. Rucandio, CIEMAT; A. Garnica-Soto, INIA National Institute for Agricultural and Food Research and Technology; A. Varela-Lopez, Universidad de la Sabana / Engineering; E. Conde, CIEMAT; J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment; F. Torrent, Universidad Politecnica de Madrid / Escuela Superior de Ingenieros de Montes; D. Hernandez-Moreno, INIA / Environment

In the framework of the H2020 Project GUIDEEano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on the the toxicity and bioaccumulation of these NPs trying to establish some relationships between coatings and the related effects. Bioaccumulation studies with rainbow trout have been performed for CeO$_2$ NPs and TiO$_2$ NPs of 4-8 nm uncoated and coated with citrate or polyethylene glycol phosphoric acid ester (PEG). OECD Test Guideline (TG) 305 (diet administration) has been followed. Fish (5±1 g weight) were fed for 10 days with a diet spiked with 100 mg/kg of the NPs dispersed in water. A control group fed with pellets containing the vehicle (water) was tested in parallel. This uptake phase was followed by a depuration phase of 42 days. Whole fish, stomach and intestine were collected at different time points (0, 10, 11, 17, 24, 38 and 52 days). In addition at the end of the uptake and depuration phase liver and gills were also collected. The levels of the metals in these tissues were measured by inductively coupled plasma mass spectrometry after an acid digestion. During the treatment and depuration phase, no signs of toxicity and no differences in fish growth or in the hepatosomatic index among groups were recorded. At the end of the uptake phase levels of Ti could be measured in stomach, gills and liver without differences among TiO$_2$ NPs. A difference was observed for the uncoated NPs for which Ti levels in the fish were higher than for the other coated NPs. Ti levels reached basal values already in the first day of depuration indicating an almost complete detoxification of these NPs from the organism. Higher levels of Ce with respect to the control group could be measured at the end of the uptake phase in stomach, intestine and gills but not in liver. Ce levels were found in fish treated with the coated NPs but not in the group treated with the uncoated NPs. Levels of Ce could be measured the first day of depuration in stomach and intestine of fish treated with CeO$_2$ NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO$_2$ NPs uncoated or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO$_2$ NPs. These results indicate a different behavior for the CeO$_2$ NPs and TiO$_2$ NPs. No relationship could be observed between the coating and the observed effects. Acknowledgements: EU FP7 project 604387 GUIDEEano.

TU090 Colloidal characterization of nano-enabled products for the restoration of works of art: environmental fate of nano-ingredients

E. Badetti, M. Schmutz, M. Giubilato, M. Picone, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; V. Cazzagon, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; A. Bonetto, University CaFoscari Venice / Environmental Science, Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice; E. Giardini, M. P. Cortelazzo, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; A. Volpi Ghirardini, University Ca Foscari Venice / Department of Environmental Sciences Informatics and Statistics; C. Giuliani, G. Di Carlo, CNR ISMN; M. Salzano De Luna, M. Lavorgna, CNR IPCB; A. Marcomini, University of Venice / Department of Environmental Sciences Informatics and Statistics

The development of highly innovative techniques and technologies for artworks preservation is providing conservators with new engineered nanomaterials (ENM) and ENM-based formulations that can enhance performance and technical sustainability of art materials [1]. However, the human health and environmental impacts that may potentially emerge from these new materials and/or technologies are still little known and requires an adequate assessment and management of potential risks [2,3]. ENM formulations are increasingly preferred for conservation interventions compared to the corresponding bulk materials formulations because of their small size and enormous specific surface area that favour their interaction with the material to be conserved/restored. But the small size, coupled with their capacity to adsorb biomolecules within their structure, can enable transport to reach sub-cellular locations leading to potentially higher localized concentrations and toxicity. A lot of factors such as size, shape, surface coating and the fact that these particles are subject to fast alteration, make complicate the elucidation of the interaction mechanisms of these nanomaterials with the artefact material and the surrounding environment including the nano-bio interaction. In this context, in the frame of the H2020 NANORESTART project, innovative new approaches were developed aimed at making nanomaterials more reliable for use in cultural heritage conservation. In the present work, the colloidal characterization of the new formulations was performed by means of Dynamic Light Scattering (DLS) and Centrifugal Separation Analysis (CSA) techniques. Moreover, possible releases from outdoor conserved works of art were also investigated by immersion tests, simulating the exposure of the treated materials to the worst applicable environmental conditions (e.g. rain, humidity, temperature).
risks and having batch-to-batch uniformity. Finally, notifying bodies are behind development because of the uncertainties arising from this field. Therefore, it seemed important to include in the framework the following aspects: safe material’s design, human health and environmental risks, manufacturing, storage and transport and the regulations related to the topic at hand. At the end of the project, the Safer-by-Design framework will be used as a structural backbone for creating nanospecific guidance in the framework. The guidelines aim to facilitate the communication among the different stakeholders in the value chain and with regulators for safe and sustainable innovation.

TU093 Review of the applicability of early-stage sustainability methods integrating technoeconomic and environmental assessments
C. Fernandez Dacosta, University of Utrecht / Copernicus Institute; P. Wassenaar, National Institute for Public Health and the Environment (RIVM); I. Dencic, Corbion; M.C. Zipf, RIVM / Centre for Sustainability Environment and Health; A. Morao, Corbion; L. Shen, University of Utrecht / Copernicus Institute; E. Heugens, RIVM / Centre for Safety of Substances and Products; L. Posthuma, RIVM / Centre for Safety of Substances and Products

The chemical industry strives for the development of bio-based alternatives for present fossil-based chemicals driven by the transition to a bio-based economy. Key in this transition is “safe and sustainable by design”, which means safety and sustainability are taken into account at the earliest possible development stages. Many sustainability assessment methods are developed for this purpose. The aim of this study is to evaluate a selection of 12 early-stage methods (ESMs), their applicability, the relevance for bio-based chemicals and the coherence of their outcomes, using bio-based lactic acid as a retrospective case study. The selected methods contain at least one of the following themes: energy, climate change, eutrophication, land use, human toxicity and ecotoxicity. These six themes were considered as most relevant for the case of bio-based lactic acid. The selected early-stage methods point to the right hotspots concerning energy and climate change, which is promising for application during process design. In general, the selected ESMs define simple environmental and toxicity indicators that have lower data requirements and are faster to implement than full assessment methods. However, the results they provide have intrinsically a higher level of uncertainty. Besides, the ESMs existing in the literature do not meet important criteria for utility. They are often not clear in the definitions of the environmental and toxicity indicators neither transparent in background data sources and not up-to-date. Important limitations of the selected ESMs are 1) narrow life cycle scopes (excluding the environmental impacts of material and biomass feedstock production) and 2) omission of some environmental aspects relevant to bio-based material’s design, production and use in general. Within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

TU094 Liquid organic hydrogen carriers (LOHC) - comparative hazard assessment
M. Markiewicz, Technical University of Dresden / Sustainable Chemistry Group; Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry

Renewable energy stored in LOHC systems could replace fossil fuels yet their environmental impacts are largely unknown. This technology is still relatively new, and requires R&D efforts to optimise its performance to commercially attractive levels. This opens the possibility to proactively design the carriers for increased operational and environmental safety. A preliminary, comparative hazard assessment was performed using automotive diesel oil as a reference. The biodegradability and acute/subchronic (eco)toxicity using: enzymes (acylcholine esterase), cell lines (IPC-81), bacteria (Vibrio fischeri), algae (Raphidocelis subcapitata), freshwater plants (Elodea minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinoline, ethyl-, propyl-, butylcarbazole. Each LOHC system was dosed: H₂-lean, H₂-rich and partially hydrogenated. Low to moderate (eco)toxicity, comparable to automotive diesel oil, was observed for the quinoline LOHC system. No effect occurred in aquatic tests for H₂-lean alkylcarbazoles due to unsuitable exposure. The H₂-rich forms were moderately cyto-ecotoxic. High cytotoxicity was observed for partially hydrogenated alkylcarbazoles, with the effect increasing with the chain length. Alkylcarbazole LOHC systems were generally more toxic than diesel oil. None of the LOHC chemicals show appreciable biodegradation except quinoline. Further biodegradability test under less stringent conditions are needed to investigate potential persistence. Additionally, hydrophobicity of H₂-lean and intermediate forms of alkylcarbazoles (log D 3.6-4.8) indicates that they might be bioaccumulative. Nonetheless, undeniable socioeconomic benefits come from the fact that LOHC energy systems can operate on renewable energies. Moreover, this LOHCs are more favourable in the terms of handling and transportation safety. The composition of LOHC systems is much better defined than it is in case of fossil fuels, which facilitates standardisation or quality control. This study also showed that many of the standard (eco)toxicity testing approaches are not well suited for LOHC systems showing moderate to high hydrophobicity as it is the case for diesel oil.

TU095 1-Octanol and 2-Butanone as biofuel candidates - Using “Green Toxicology” for biofuel development
H. Hollert, RWTH Aachen University / Institute for Environmental Research; S. Heger, Institute for Environmental Research RWTH Aachen University;  A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Du, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis
This development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These biochemical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embrittlement and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of some biobased derived fuel candidates 2-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations >2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanol did induce effects in concentrations between 7-15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster “Techno in the last years one of the most profitable industries. The majority of cosmetics are composed of chemicals generally as emulsions. Given the ease of synthesizing DESs, along with their low cost, it is thought to a possible use of them in the formulation of cosmetic and beauty products. Some of these DESs contain nitrogren (N), which can be used as fertilizer in the growth of the crops. Another field of interest could be the agriculture as well: some of these solvents can be produced as gels, meaning of the use of them as fertilizers. Toxicological studies on ChCl+Glycerol and ChCl+Levulinic Acid (never before studied) on algae species of the genus Symbiodinium and on skin in vitro cells have been carried out in order to extend the limited knowledge about toxicity at environmental and human level, as well as the biodegradation pathway of this family of solvents. Preliminary results show extremely low toxicity on Symbiodinium clade B, known to be highly sensitive to environmental stress, for all the tested mixtures. Algae growth and Reactive Oxygen Species (ROS) production, a general indicator of stress, it is indeed not affected by all the tested compounds in the order of g/L. Results from the present study indicate an expected safer

New frontiers in Life Cycle Inventory data collection and modelling (P)

TI/097 Predicting environmentally beneficial production pathways for chemicals with neural networks
J. Klunkendorf, RWTH Aachen University, Institute of Technical Thermodynamics / Institute of Technical Thermodynamics; M.R. Tillmanns, A. Sternberg, RWTH Aachen University / Institute of Technical Thermodynamics; A. Bardow, RWTH Aachen University
Life Cycle Assessment (LCA) has gained wide acceptance as methodology to evaluate the environmental impact of chemical processes. However, LCA requires detailed data on mass and energy balances. Data is usually limited for processes in stages of early development. For these cases, predictive LCA approaches are required. Current predictive LCA approaches employ solely molecular descriptors to estimate the environmental impacts of products. Thus, the choice between different production pathways towards the same molecule cannot be resolved. Therefore, we propose a neural network-based approach that uses both molecular and process descriptors. The resulting neural network is able to distinguish between various production pathways for the same product while still employing only data available at early stages of development such as stoichiometry. We estimate 5 impact categories including, e.g., cumulative energy demand (CED) or climate change (CC). The novel approach is compared to a neural network trained with molecular descriptors only. The results show that integrating process descriptors increases the coefficient of determination from 0.37 to 0.65 and from 0.39 to 0.65 for CED and CC, respectively. The route-specific prediction is illustrated for methanol production from CO₂ versus natural gas. It is shown that neural network models can serve as an initial screening tool for identifying environmentally beneficial new production pathways.

TU/098 A Study on the development of Food LCI DB and PCR for estimating environmental footprint in South Korea
S. Cho, SMaRT-ECO / Sustainable Business Div.; S. An, S. Seol, I. Kim, SMaRT Eco Corporation
As a result of the Paris Climate Convention adopted in December 2015, 195 countries in the world were required to implement greenhouse gas reduction, and Korea also proposed a 37% reduction target compared to BAU. In accordance with the environmental regulation of developed countries, Korea is also not free from environmental regulations at the time of preparation for active response. Under the Single Market of the EU, product environmental regulations starting from automobiles in 2008 expanded to include food in 2020, requiring the disclosure of high-quality environmental information on foods. As a result, the development of a high-quality environmental information database is accelerated, and the EU has created an ILCD Data Network to induce DB registrations in each country. However, Korea's agricultural and livestock LCA DB does not meet the ISO requirements, it is time to revise. The purpose of this study is to develop the LCA database for the estimation of the environmental footprint (PEF) of major domestic food exports to Europe and to use the common protocol and food - specific guidelines (PCR) to estimate environmental footprint , and aims to obtain EPD certification of food. To do this, we benchmarked the protocol and PCR for the Korean conditions by examining the cases of the calculation guidelines of the developed countries. In the future, it is meaningful to construct a database that can be used as basic data for obtaining PEF certification for foods exported to Europe and overseas.

TU/099 Transition from ILCD To Environmental Footprint: changes in the database structure, format, nomenclature, methods and other adaptations.
S. Fazio, EC-JRC; E. Diaconu, JRC European Commission; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
In 2013 a Communication from the Commission to the European Parliament (COM/2013/0196) established the Environmental Footprint (EF) scheme. The common methodology, nomenclature, and databases of the Life Cycle Impact Assessment (LCIA) Methods have been partly changed and adapted to fulfill the scope. Beyond that, the reference data contained in the ILCD package was found to contain some format, syntax and conceptual errors which were inherited from several data providers over time. Therefore a new database has been developed. Errors have been fixed, new files have been developed, and redundant or obsolete files have been deleted. The content of this presentation represents a synthesis, recalling general considerations or decisions, that have been applied for specific impact categories, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factors as well as proposed further implementation. Furthermore, a list of changes made from the ILCD to the EF package, beyond the LCIA methods recommended (i.e. Elementary Flows, Flow Properties, Unit Groups) and complementary objects defining the compliance (i.e. stylesheets, schemas) are described, in a change log file available through the EF-LCA website. Among the above mentioned and at once the overall changes occurred in the ILCD-EF transition phase can be resumed as following: - 1242 obsolete or wrong elementary flows have been deleted /mapped - 560 new elementary flows have been created - Around 55.000 characterisation factors are different (this is mainly due to the introduction of new methods, and regionalization of some of them) - 37 duplicated flows have been eliminated - 275 wrongly categorized flows have been assigned to the proper category - 218 wrong or useless flow properties have been deleted and mapped to the remaining ones - 35 unit groups have been deleted, one new has been created.

TU/100 New tools for Environmental Footprint data checking and sharing: Soda4LCA, ILCD validator and Registry for the node management
S. Fazio, EC-JRC; E. Diaconu, JRC European Commission; O. Kusche, OkworX; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
Several tools for Life Cycle Inventory data development, validation, sharing and registration to the Life Cycle Data Network (LCDN) have been released by the EC since 2007, and improved after the official launch of the LCDN (2014). All those tools were originally meant for the International Life Cycle Data Cycle (ILCD) scheme. Since 2013 after a specific EC Communication (COM/2013/0196) the Environmental Footprint (EF) scheme has been developed and led to significant changes in the structure of the ILCD/LCDN. During the development of EF compliant data, the tools had to be adapted and improved to fulfill new requirements. Particularly the following tools and software have been changed: - ILCD validation tool: software for the compliance assessment of datasets (format syntax, archive structure, nomenclature, links and orphaned items, categorization, etc.) - soda4LCA: software for distributing data based on the ILCD data format, with search and management functions, including the data registration in the LCDN - LCDN registry: online registration facility that can provide data from different nodes running on soda4LCA, and meant to make available only fully compliant data (while the nodes can host also intermediate data) The changes that have been applied can be summarized as follows: - ILCD validation tool: additional validation profiles added for EF scheme. Checks against different parameters for Elementary Flows, location IDs, new LCIA methods, Flow Properties, Unit Groups and schemas, according to the changes made in the DB structure - soda4LCA: new access profiles are available for data stocks. The developer can now select entire data stocks and restrict the access only to authorized users. The entire data stock can be now downloaded directly, while before it was possible only at the single dataset level. The registration form includes a statement for the use of data within the EF framework. Declaration of compliance in the registration phase and possibility of multiple registration in more than one registry at once (a dataset can be both ILCD and EF compliant and therefore registered in two registries with different compliances declared) - LCDN registry: a dedicated registry has been developed for EF, with new functions. The compliance scheme is now visible (before was implicit since only ILCD was possible), possibility to register entire batches of data at once (before each single dataset had to be registered manually). Search interface improved.

TU/101 Improving the consistency and the accuracy of water inventories of chemical sites in PlasticsEurope LCI’s in the perspective of the applicability of the impact assessment methods of EF and ILCD
M. Baird, thinkstep / LCA; G. Castelan, PlasticsEurope / LCA
The ISO 14046 standard has clarified the definitions of water use and of water consumption which is the part of water withdrawn from a drainage basin not returned back to the same drainage basin. These only definitions have enabled PlasticsEurope to fix a number of important inconstancies in its eco-profile protocols, where use and consumption are sometimes used synonymously. This presentation will focus on this short term action, in perspective of enabling the application of the latest conventional water assessment method AWARE to the water consumption, PlasticsEurope and thinkstep have collaborated to improve the consistency of the data collection phase of water flows for the various projects of the program. For the purpose of good water management in a chemical plant, plant managers need to have a good knowledge of all the water flows inputs, their origin (lake, river, public supply, underground...), their treatment, in what equipment or process they are employed like for example in a cooling towers or being injected in the chemical process like in steam cracking. They must know the post-use-treatment and where all the outputs
end (back to the river, evaporated, in the public sewage network, in the product...). For the purpose of consistency of the Life Cycle inventory phase, it is then very important to report these collected operational flows in the ILCD input and output flows the right and same way whoever the LCA practitioner is. This will be the basis for the calculation of the consumptive water (output minus input within the same drainage basin) and the application of AWARE. The presentation elaborates on the various operational inputs of water in a chemical plant and the link to the life cycle inventory phase and ILCD flow names. This is based on the PlasticsEurope methodology for calculating eco-profiles. It is expandable or adaptable to all kind of industrial sites. A similar work would need to be conducted on all datasets so that the consistency of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint in order to go LCA. The presentation aims to attack LCA (water experts and scientists as well as people applying the water methods in practice to exchange on challenges, relevancy of aspects and to align on a continuous improvement of water data, regionalization efforts and method improvement in the future, to inspire broad application.

TU102
Methodological improvements by dynamic approaches for the life cycle assessments of buildings
K. NEGISHI, CSTB; L. Barna, INSIA Toulouse / LISBP; Y. Pigné, Université de l’Havre; T. Navarrete-Gutierrez, LIST; N. SCHIOPU, A. Lebert, CSTB; T. Gibson, Luxembourg Institute of Science and Technology (LIST)/ Environmental Research and Innovation; T. Defourny, Belgian Institute of Science and Technology (LIST)/ Environmental Research and Innovation Nowadays in France, environmental and energy rules for the construction sector are based on environmental performances of products assessed through LCA methodology. However, the actual practice of LCA is lacking of temporal dimension whereas the temporal evolution during the long lifetime span of buildings has to be taken into account for overall LCA results. A new framework of LCA method was recently proposed by L.Barna et al (2016) and A.Shimako et al (2017) with a particular attention to the process and supply chains dynamics (web tool DyPLCA, http://dyplica.pigne.org/), aiming at calulating time dependent environmental interventions and the related impacts of toxicity and climate change. The aim of this study is to investigate the environmental performances over a large time span of two low-energy single houses, one on concrete and one on timber. The time dimension was integrated on both LCA steps (LCI and LCIA) using the framework cited above. The implementation of dynamic LCA took several steps. Buildings life cycles were first modeled in SimaPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions matrix was then used with DyPLCA web tool for temporal LCI calculation. The temporal characterization of the product system considered two parts. Temporal characteristics of the foreground system were related to the building construction, materials replacement and renovation activities during the building’s life time of 100 years. The temporal characteristics of background processes were previously integrated in a dedicated database and used with DyPLCA tool. The implementation of environmental interventions distributed in time, was then used for climate change impact calculation in function of time. Two indicators were calculated in function of time: mean temperature change and radiative forcing. The new method allows considering fossil and biogenic carbon for climate change proposes without clashing on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic approach can help on our carbon footprint. A more thorough understanding and a more consistent analysis of environmental impacts of buildings. However, simulation time and memory usage for dynamic LCI calculation can be a principal limitation for the practice of dynamic LCA.

TU103
Carbon footprint from Brazilian soybeans based on spatially-explicit life cycle inventories, including land use change
N. Escobar, University of Bonn / Institute for Food and Resource Economies ILR; J. Godar, Stockholm Environmental Institute
That location matters when it comes to quantifying environmental impacts of agricultural commodities, because of the increase in the use of the LCA literature. Authors tackle the influence of spatial variability by capturing differences in agricultural practices, transport options and industrial processing sites in the life cycle inventory (LCI). This information is, however, incomplete when quantifying impacts of agricultural commodities that are produced in large amounts and traded worldwide, e.g. soybean. Despite the efforts from the Input Output Analysis, it is not currently run analyzing these impacts. A new approach requires the use of aggregated resource consumption and emission data for environmental extensions, which provides little detail on the technological and logistic factors contributing to overall ecological footprints. From the LCA perspective, total nation’s supply is made of thousands of individual life cycles throughout the whole supply of seed, oil, and cake to the international market. These include the following life cycle stages: land use change (LUC), soybean farming, domestic transport, export, and crushing, dealing with allocation challenges. In this way, our approach represents the convergence between top-down Multi-Regional IO analysis and bottom-up Attributional LCA. Preliminary results highlight the relevance of this approach that adds further detail to the entire supply chain, namely LUC, for which considering sub-national scales is crucial in the quantification of climate change impacts. Outcomes support the argument that importing countries of soybean-based commodities should take responsibility on deforestation and associated carbon emissions, provided that spatial explicit data is available. This transparency tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.

TU104
Carbon Footprint Projections for Japan Using Computable General Equilibrium
Y. Ichisugi, Tokyo City University; T. Masui, National Institute for Environmental Studies; N. Isubo, Tokyo City University
In 2015, Science Based Targets (SBT) has been paid attention to the world. The targets adopted by companies reducing greenhouse gas (GHG) emissions to keep global temperature below 2 degrees increase from that of preindustrial revolution. About 3,000 companies in the world declared to follow their targets. The target to the mitigation would be based on the calculated results of Integrated Assessment Models (IAM) such as Asia-Pacific Integrated Model (AIM), Integrated Model to Assess the Global Environmental (IMAGE). However, these results usually don’t consider the entire supply chain, because of the differences of the aims of application. In contrast, Life Cycle Assessment (LCA) considers the entire value chain. On the other hand, IAMs only use the aggregated resource consumption and emission data for climate change proposes without clinging on to fixed characterization factors contributing to overall ecological footprints. From the LCA perspective, total nation’s supply is made of thousands of individual life cycles throughout the whole supply of seed, oil, and cake to the international market. These include the following life cycle stages: land use change (LUC), soybean farming, domestic transport, export, and crushing, dealing with allocation challenges. In this way, our approach represents the convergence between top-down Multi-Regional IO analysis and bottom-up Attributional LCA. Preliminary results highlight the relevance of this approach that adds further detail to the entire supply chain, mainly LUC, for which considering sub-national scales is crucial in the quantification of climate change impacts. Outcomes support the argument that importing countries of soybean-based commodities should take responsibility on deforestation and associated carbon emissions, provided that spatial explicit data is available. This transparency tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.

TU105
Network LCA as a tool to enhance data collection and usage in a value chain perspective
M. van der Velden, VTT Technical Research Centre of Finland; M. Myllysilta, S. Majanenemi, VTT Technical Research Centre of Finland Ltd
Keywords: LCA, data collection, value chain Life cycle assessment as defined by the ISO (14040) consists of four phases. First, the goal and scope are defined, after the inventory analysis is performed followed by the life cycle impact assessment. At the end, the results are interpreted. The inventory analysis includes the following steps: definition of the boundaries, collection of background data, enabling a better comparability of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint. Firstly, the data collection. There are many challenges related to inventory analysis. Secondly, the data provider might hold the data confidential. This is because the data are collected from various sources and the sources might be from different organization than the commissioner of the study. Secondly, the data provider might hold their data confidential. This is because the recipes might be secret, i.e. the raw materials and the amounts of raw materials and/or the amount of energy consumed in the production process reveals the cost structure of the product. Thirdly, the data provider typically gets no benefit from delivering data and putting a lot of effort to collect and get together the data. This may decrease the motivation to deliver data. The fourth aspect is the unwillingness of data providers to reveal their performance indicators to competitors, if considered that their environmental performance is better than those of the competetions. Firstly, it is seen as the most time consuming phase of every Life cycle assessment study. This is because the data are collected from various sources and the sources might be from different organization than the commissioner of the study. Secondly, the data provider might hold their data confidential. This is because the recipes might be secret, i.e. the raw materials and the amounts of raw materials and/or the amount of energy consumed in the production process reveals the cost structure of the product. Thirdly, the data provider typically gets no benefit from delivering data and putting a lot of effort to collect and get together the data. This may decrease the motivation to deliver data. The fourth aspect is the unwillingness of data providers to reveal their performance indicators to competitors, if considered that their environmental performance is better than those of the competetions. Firstly, it is seen as the most time consuming phase of every Life cycle assessment study. This is because the data are collected from various sources and the sources might be from different organization than the commissioner of the study. Secondly, the data provider might hold their data confidential. This is because the recipes might be secret, i.e. the raw materials and the amounts of raw materials and/or the amount of energy consumed in the production process reveals the cost structure of the product. Thirdly, the data provider typically gets no benefit from delivering data and putting a lot of effort to collect and get together the data. This may decrease the motivation to deliver data. The fourth aspect is the unwillingness of data providers to reveal their performance indicators to competitors, if considered that their environmental performance is better than those of the competetions. Firstly, it is seen as the most time consuming phase of every Life cycle assessment study.
Developing guidelines for elementary flow nomenclature

A. Edelen, ORISE; W. Ingwersen, US EPA

In general, a flow in life cycle inventory data refers to an input or output to a process. Flows may be of two broad types: elementary flows or intermediate (known as “technosphere”) flows according to ISO 14044 (ISO 14044 2006). Elementary flows are direct inputs of mass, energy or space that are used directly from the environment or released directly back into the environment. Life cycle assessment (LCA) data providers are currently not using a common list or system of elementary flows. An early activity within the UNEP-SETAC Life Cycle Initiative was the creation of a recommended list of flow exchanges by the Data Availability and Data Quality Workgroup (de Beaufort-Langvedel et al. 2003). Elementary flows in all life cycle inventory and life cycle impact assessment sources used in a model must correspond, or match, in order to build a functional LCA model. Edelen et. al. 2017 formulated recommendations on formatting and management based on a critical review of elementary flows from eleven LCA sources. These recommendations have been used to categorize flow information into three components and flow metadata into six components. These structured components of flows allow for systematic analysis and structuring of flow components through a knowledge organizational structure (KOS). The ISO 14048 standard was used to structure the different flow and metadata components as exclusive, inclusive or user-defined nomenclatures. The KOS is maintained in a user friendly, publically accessible interface through the US EPA terminology services. This research presentation will focus on describing the benefits of the KOS approach and the tools users can employ to provide an example application of the KOS to current elementary flow nomenclature. References [1] de Beaufort-Langvedel A, Bretain R, Hischier R, Huijbrechts M, Jean P, Tanner T, van Hoof G (2003) Code of life-cycle inventory practice. SETAC Press, Pensacola, FL [2] Edelen A, Ingwersen W, Rodriguez C, Alvarenga R, de Almeida AR, Wernet G (2017) Critical review of elementary flows in LCA data. INT J LIFE CYCLE ASS. https://dx.doi.org/10.1007/s11367-017-1535-3 [3] ISO 14044 (2006) ISO 14044: Environmental management--Life cycle assessment—Requirements and guidelines. International Organization for Standardization, Switzerland

Building a Life Cycle Inventory of stormwater pollutant fluxes: model evaluation for a separate residential urban catchment

E. Risch, IRSTEIA Montpellier / UMR ITAP; P. Roux, Istrea / ITAP ELSA-PACT; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istrea / UMR ITAP; C. Sinfort, Itrea, Montpellier SupAgro, Univ Montpellier / ELSA Research group and ELSA-PACT Int. Institute for Environment and Development, UMR ITAP


Tissue specific 32P accumulation and consequent biological effects in bivalve molluscs

E. Vernooij, The University of Plymouth / School of Biological & Marine Sciences; J.T. Smith, University of Portsmouth / School of Earth and Environmental Sciences; A.N. Jha, Plymouth University / Biological Sciences

1. Introduction

The aquatic environment is the habitat and recipient of anthropogenic pollution, including radionuclides. Despite the growing concern over presence of radionuclides in the aquatic environment, there has been only limited studies to determine potential biological responses in aquatic invertebrates following exposure to environmentally realistic levels of radiation doses. This integrated study determines and compares tissue specific bioaccumulation, doses delivered and induced biological damage in two species of mussels, the freshwater species Dreissena polymorpha (DP) and marine Mytilus galloprovincialis (MG), following exposures to an important radionuclide, phosphorus-32 (32P).

2. Materials and methods

The study involved 10 day exposures of mussels to 32P of varying dose rates (i.e. 0.10, 1.0 and 10.0 mGy/d) taking into account a current no-effect screening value of 0.24 mGy/d (European Commission). The first set of studies determined 32P accumulation in specific mussel tissues (i.e. adductor muscle, digestive gland, mantle, gills and ‘other’), internal mussel water (water inside the mantle cavity), shell and faecal matter using scintillation techniques. From this bioaccumulation study, we were able to highlight key tissues of interest; the digestive gland for example, received the greatest proportion of 32P independent of mussel species. In the next set of studies, a suite of biological responses on mussel tissues were investigated in digestive gland and gill cells. This included the induction of DNA damage ( Comet assay) and repair response ( Gamma-HAXZ), the induction of micronuclei (MN) and the expression of key stress related genes (i.e. SOD, CAT, GST, HSP70/90). These results suggest that EE2 does not induce Vtg in ng/L EE2, Vtg levels were not higher in the exposed organisms than organisms done at a higher feeding regime (currently being analysed) will confirm this result. Mytilus galloprovincialis (Spain) were collected in autumn/winter, corresponding with early gametogenesis as the egg precursor in female oviparous animals, is a common biomarker of estrogenicity widely used as an indicator of endocrine disruption in aquatic environments. Nevertheless, in the case of mollusks, it is still unclear if the synthesis of Vtg is regulated by steroid hormones as in the case of vertebrates. In the case of the synthetic hormone ethinylestradiol (EE2) the results of the studies are inconclusive. The aim of this work is to verify whether the synthetic estrogen 17α-EE2 induces the production of Vtg in Mytilus galloprovincialis at two exposure times and different nutritional regimes. For that, we used a shotgun label-free proteomics approach by high resolution LC-MS/MS to identify and quantify Vtg in mussels gonads. In this way, we can verify if the energetic balance is a key confounding factor in Vtg production. The relationship between the maturity state of mussels and their Vtg levels was studied as another possible confusing factor. Mussels from uncontaminated area in Galicia (Spain) were collected in autumn/winter, corresponding with early gametogenesis stage. Mussels were exposed during 4 and 24 days to 100 ng L−1 of EE2 to assess whether Vtg synthesis was induced by EE2. During exposure, mussels were fed three times per week with two different regimes: a low regime (equivalent to 0.29 % of mussel dry weight per day), or with a high regime (equivalent to 5.55 % of mussel dry weight per day), representing negative and positive energy balance respectively. For the low feeding regime, shotgun proteomics identified an detected Vtg only in female gonads. The results showed an increase in Vtg levels in mussel exposed for 4 days to 100 ng/L EE2 compared to the solvent control, although this increase was not statistically significant. In mussels exposed for 24 days to 100 ng/L EE2, Vtg levels were significantly higher than in mussels exposed to a solvent control. These results suggest that EE2 does not induce Vtg in M. galloprovincialis. However, it is possible that Vtg synthesis was impaired by the fact that organisms were in negative energy balance. The results of the experiments done at a higher feeding regime (currently being analysed) will confirm this result. A significant correlation was found between Vtg levels and the maturation state of female mussels, indicating that maturation state is a confounding factor for the application of Vtg levels in eco-toxicology studies.
Integrating natural processes in environmental hazard assessments of the oil sands

D. Nunes Cardoso, CESAM, University of Aveiro / department of Biology & CESAM; J. Pestana, CESAM & University of Aveiro / Biology; S. Goncalves, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; A.M. Soares, University of Aveiro / department of Biology & CESAM; F.J. Wijmenga, University of Calgary / Department of Biological Sciences; S. Loureiro, Universidade de Aveiro / Biology

The Athabasca oil sands deposits in northern Alberta, Canada are a naturally occurring mixture of bitumen, sand, clay and other minerals. Bitumen, which is a heavy and extremely viscous oil, is mined and then subsequently reduced to produce gasoline, diesel and other hydrocarbon-based products. Moreover, the naturally occurring Athabasca Oil sands deposits are a source of both physical and chemical stressors to regional rivers that flow through the deposit. Physical stress on aquatic biota from natural bitumen results from hillslope erosion processes and slumping of material into the rivers, while chemical stress arises from bitumen-derived contaminants entering the waters. To fully understand the ecological and cumulative effects of oil sands mining activities on aquatic ecosystem water quality and associated biological structure and function, there is a need to evaluate the effects of naturally occurring bitumen in the aquatic environment. The main objective of this study was to evaluate the possible ecotoxicological effects associated with the slumping of river bank material (i.e. oil sands deposit that naturally enters the river systems through fluvial geomorphological processes). A series of inter-related laboratory ecotoxicological assays were conducted using biotic and abiotic derived effects on the offspring and population dynamics (provided from different sources in regional rivers (SP, ATB, STB and ELLs). All ecotoxicological results were complemented with the chemical analysis of metals, naphthenic acids (NAs) and polycyclic aromatic hydrocarbons (PAHs) to understand the possible effects that this material will induce when in contact with aquatic systems. All tested organisms responded negatively to the presence of oil sands material through toxic testing liquid media or through sediment contamination with solid oil sands material. A pattern of toxicity was also observed, where the SP source material was the less toxic and ELLs material being more toxic. These results corresponded with the chemical analysis which showed the ELLs sample having high levels of PAHs and NAs. In summary, tests revealed that oil sands material affected model organisms under laboratory exposures, especially in samples with more NAs and PAHs content.

TU11
Genomic DNA methylation level: a stress molecular marker in the species Gammarus fossarum

P. Cribiu1, 2, 8, N. Bury1, 9, H. Ibarra1, 2, 3, K. Perea1, 2, 3, T. Rio1, 2, 3, T. Sagi1, 2, 3, A. Fantin2, 3, 8, 10, S. Loureiro1, 2, 3, 4, 5, P. Monteiro1, 2, 3, 4, 6, M. Araújo2, 3, 4, 8, K. Jonsson1, 2, 3, 4, 8, 11

The presence of contaminants in the environment results in a perturbation of biological processes. A major challenge is to examine how various contaminants induce stress responses at the level of individual organisms and populations. Here, we assessed the genomic DNA methylation level in the invertebrate Gammarus fossarum, a known stress marker in invertebrates. DNA methylation measurement was performed in a series of inter-related laboratory ecotoxicological assays conducted using biotic and abiotic derived effects on the offspring and population dynamics (provided from different sources in regional rivers (SP, ATB, STB and ELLs). All ecotoxicological results were complemented with the chemical analysis of metals, naphthenic acids (NAs) and polycyclic aromatic hydrocarbons (PAHs) to understand the possible effects that this material will induce when in contact with aquatic systems. All tested organisms responded negatively to the presence of oil sands material through toxic testing liquid media or through sediment contamination with solid oil sands material. A pattern of toxicity was also observed, where the SP source material was the less toxic and ELLs material being more toxic. These results corresponded with the chemical analysis which showed the ELLs sample having high levels of PAHs and NAs. In summary, tests revealed that oil sands material affected model organisms under laboratory exposures, especially in samples with more NAs and PAHs content.

TU11
Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river

V. Svara, Helmholtz Centre for Environmental Research GmbH / Effect-Directed Analysis; M. Krauss, Helmholtz Centre for Environmental Research - UFZ / Effect-Directed Analysis; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology

Many aquatic organisms are sensitive to man-made chemicals in the water. However, some species tolerate the occurrence of toxic chemicals and at the same time benefit from the nutrients that are often abundant in polluted waters. Such is also an amphipod species Gammarus pulex (Crustacea, amphipoda), which can be found throughout a pollution gradient of a stream. We investigated whether G. pulex individuals have an ability to adapt to the pollution gradient and to survive likewise in pristine and in polluted sites or whether different conditions select for different phenotypes within the population. G. pulex individuals were sampled at different sites along a pollution gradient in the river Holtemme (Saxony-Anhalt, Germany). Individuals were characterized with respect to pollution burdens of water and amphipod tissues. Amphipods from three sampling points were brought alive to the lab and exposed to the insecticide Imidacloprid, which was found in water and animal samples beforehand. Lethal time for 50 % (LT50) values were determined and movement activities and moulting rates were recorded. Mortalities in the Imidacloprid treatments clearly differed for amphipods sampled at different sites; animals from more polluted sites were more sensitive to the toxicant and also exhibited reduced movement and moulting activities. We examined whether these differences in toxic sensitivities were related to differences in toxicokinetics of Imidacloprid by quantifying imidacloprid tissue levels after different times of exposure to the compound but toxicokinetics of imidacloprid proceeded similarly in animals from different sites. Population genetics approaches (sequence comparisons of a DNA stretch of the cytochrome oxidase I (COI) gene and comparisons of 9 microsatellite loci) revealed that differences in conditions between sites did not lead to the separation of distinct subpopulations suggesting that survival of individuals at each site is based on individual acclimation and not on adaptation to specific conditions by a distinct subpopulation.

TU14
Antenna Regeneration of the Marine Amphipod Parhyale Hawaiensis as a Possible Endpoint in Ecotoxicology - Preliminary Data

O. Diehl, P. Assano, G. Umbuzeiro, School of Technology, UNICAMP / LAEG Parhyale hawaiensis is a marine amphipod of worldwide circumtropical distribution and has been an ecological toxicological test species. P. hawaiensis is able to regenerate its appendages, limbs and tissues after an injury or loss during the entire course of their life. Regeneration can be used as an ecotoxicological endpoint to assess potential teratogenic compounds and their impact on stem cells. Studies suggest that P. hawaiensis has local progenitor cell in each part of body. It was already been demonstrated that P. hawaiensis has a fast regeneration of thoracic limbs, within a week, but no information on antennae's regeneration was found. Thus, the aim of this study was to obtain data on regeneration of antennae of P. hawaiensis to determine the viability this endpoint on toxicity tests. On day one left antennae of six month old organisms were amputated with sterilized tweezers, each
organism transferred to recipients containing 100 mL salt water and a picture of each organism was taken under a stereomicroscope. Each test consisted of 20 organisms, 10 males and 10 females. During this period, organisms were fed three times a week, the necessary conditions of salinity, temperature, aeration, substrate and luminosity were provided. Four independent experiments were performed. The organisms were monitored daily until all of them undertook full regeneration. At the end of the experiment, another pictorial test was done to determine the difference between the length (mm) before and after full regeneration. Antennae regeneration occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently, Males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxics to determine their antigenotoxic process in the developed experimental conditions. Acknowledgement: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq-PVE Process: 400362/2014-7) for funding and PIBIC for undergraduate fellowship. Amanda dos Santos e Gabriel Rampazzo Magalhães for technical contribution.

TU115

Added value of community approaches in environmental risk assessment

M. Hammers-Wirtz, T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; A. Toschki, Research Institute gaiac

Community studies are an ecologically relevant tool to assess effects of stressors on population and community level. With these kinds of studies direct as well as indirect effects (1) as a screening tool addressed to lower tier testing to get a broader idea about the relevant effects on ecosystem structure and function; 2) as monitoring tool for products which passed risk assessment to check up on community level effects; 3) as monitoring tool for typical sequence scenarios of different products which will be used together in one crop. Here exemplary results of community studies and a screening study will be presented.

TU116

Metal pollution and macro-invertebrate communities in the Olifants River, Western Cape, South Africa

J. Lucas, Cape Peninsula University of Technology / Department of Conservation and Marine Sciences; B.G. Struyman, Cape Peninsula University of Technology / Biodiversity and Conservation; J. Odendaal, Cape Peninsula University of Technology / Department of Environmental and Occupational Studies.

Freshwater ecosystems are considered among the most threatened, as a result of current trends in water utilization globally. Within the Western Cape, 76% of rivers are polluted and run the risk of irreversibly losing their ability to support ecosystems. Understanding the impact of anthropogenic activities on water quality and quantity. Numerous pollutants result from these activities, with metals and traces of non-standard species that cannot be covered by the current lower tier studies. However, community tests were often criticised for their high variability and low statistical power. In the last decade, sampling methods have been optimized and a pragmatic approach for MDD categorization has been developed to evaluate effects with regard to their statistical power. Furthermore, in the last years there is an increasing concern that current risk assessment is related to a single product while in the environment the populations are exposed to a multitude of different plant protection products. In principle, in those community test systems also multiple mixtures or typical sequences of products can be tested. Due to the characteristic of the cur-rent risk assessment procedure sequences of different products are not yet considered. In conclusion, community studies are often noticed only as tools to defend single plant protection products without recognizing their outstanding ecological value. These studies are still the most realistic approach to assess effects on population and community level under realistic environmental conditions. The position and the order of these highly informative studies in risk assessment should be rethought. We suggest further options to integrate community approaches in risk assessment procedures and to develop community test systems to be able to predict the effects of chronic and acute environmental conditions. Furthermore in community studies we use field collected larvae which are adapted to laboratory conditions creating a target flow. The test containers are filled with medium and contains ten organisms, 10 males and 10 females. During this period, organisms were feed three times a week, the necessary conditions of salinity, temperature, aeration, substrate and luminosity were provided. Four independent experiments were performed. The organisms were monitored daily until all of them undertook full regeneration. At the end of the experiment, another pictorial test was done to determine the difference between the length (mm) before and after full regeneration. Antennae regeneration occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently, Males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxics to determine their antigenotoxic process in the developed experimental conditions. Acknowledgement: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq-PVE Process: 400362/2014-7) for funding and PIBIC for undergraduate fellowship. Amanda dos Santos e Gabriel Rampazzo Magalhães for technical contribution.

TU117

QWATER - Bioassay integration under the European Water Framework Directive?: A step towards an ecological approach

M. Martínez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; P. Acevedo, IREC-Instituto de Investigación en Recursos Cinegéticos; A.I. País-Costa, MARE-EBI; L.R. Vieira, ICBAS & CIMAR, University of Porto / Department of Environment and Occupational Studies; L. Alvárez-Ospina, Universidad Potsdam; L. Guillermino, ICBAS & CIMAR University of Porto / Department of Biology; R. Ribeiro, Universidade de Coimbra / Life Sciences; J.C. Marques, IREC-Instituto de Investigación en Recursos Cinegéticos; M. Hammers-Wirtz, T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; A. Toschki, Research Institute gaiac

The Water Framework Directive (WFD) is the most important piece of water legislation in Europe. It aims at ensuring the ‘good water status’ of EU water bodies and includes both chemical and ecological status. To achieve and assess a ‘good ecological status’, the WFD advocates the integration of various lines of evidence, and demands a set of low-cost tools and techniques to deliver appropriate data. The WFD accounts for chemical, biological and ecological evaluation requirements regarding the establishment of cause-effect relationships in the assessment of environmental quality. Under this approach, the European Marine Curie QWATER project was aimed to gauge the ecological relevance of integrating short-term toxicity bioassays and biomarkers into quality elements in the WFD, as these may contribute to our ability to assess and manage EU water bodies. Ecologically relevant in situ cost-effective toxicity bioassays were used in a battery of in situ bioassays using representative species for several key functions in the ecosystem. Biomarkers, determined on the individuals used for the bioassays, were also integrated. Principal component analyses (PCA) were performed independently for each source of information, in order to improve the interpretation of the resultant PCA-factors in biological terms, and to verify whether the integration of ‘quality elements’ (bioassays and biomarkers) did (or did not) strengthen the robustness of the standard Ecological Quality Status approach used to assess water quality. Results shown some discrepancies in the water quality determined from each independent factor, i.e., the sampling sites were not equally ordered by all factors. Therefore, only by interpreting the values of all PCA-factors related to usual indoor stream systems, not the ecological status, the European regulatory authorities are presently in the phase of implementing the WFD based on community level approaches all over Europe. Interestingly, bioassays developed here and biomarkers, are available tools to be introduced as new feasible, cost-effective and sensitive protocols in the WFD. It might then become pertinent to stand for the combined/complementar use of ecological indicators, biomarkers, and chemical analysis for the Ecological Status of water bodies. Overall, this project allowed us to efficiently contribute to national and international efforts focused in evaluating the water quality in European water bodies.
before test start. In a first step the test conditions were adapted to the requirements of mayfly larvae. Therefore testing of different media was performed. It turned out that, contrary to testing of stonefly larvae, which is performed in Cu-reduced dilution water, moderately hard reconstituted water (according to EPA) works best for testing of mayfly larvae. Instead of Tetramin®, which was used in stonefly testing, the green algae Desmodesmus subspicatus was used for feeding of mayfly larvae. For that purpose mayfly larvae were acclimated for 48 hours, the acclimation period was extended to seven days before test start. Under these conditions mayfly larvae showed an acceptable mortality of test organisms. The next step is to perform a test with the test substance Imidacloprid which will be exposed to mayfly larvae for 21 days. Afterwards sensitivity of mayfly and stonefly larvae to Imidacloprid will be compared. The new testing method can provide toxicity data of aquatic testing by using different aquatic insects, which can be used for a SSD (Species Sensitivity Distribution) approach. The developed test system, the results of the performed tests as well as a comparison between testing of mayfly and stonefly species will be presented.

TU119 Toxic effects of a carbamate insecticide on a non-target freshwater gastropod: active ingredient versus commercial formulation


Carbamate insecticides are commonly used in agriculture for crop protection extending their toxicity through the inhibition of the enzyme acetylcholinesterase. In Argentina, the maximum concentration of carbaryl (CAR) detected in surface and subsurface drainages was 45.7 µg L⁻¹. In this study, we evaluated the subchronic toxicity of environmental concentrations of the active compound and a commercial formulation of CAR on biochemical and reproductive parameters in Biomphalaria straminea, a freshwater gastropod native to Argentina. Five treatments were included in this study: dechlorinated tap water, acetone in dechlorinated tap water (solvent control), CAR active compound (dissolved in acetone) in dechlorinated tap water at 12.68 and 126.58 µg L⁻¹, and the equivalent to 126.58 µg L⁻¹ CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were chosen so as to have the same molarity as azinphos-methyl, an insecticide previously used in our laboratory. In bioassay 1, eight glass vessels per treatment were used with six snails each. After 14 days of exposure, homogenates were made with the organisms’ soft tissues (pool of five snails per vessel). In the supernatant fraction, the following parameters were measured: cholinesterases (ChEs), carbonyl esterases (CEs) with two substrates, glutathione S-transferase (GST), glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). In bioassays 1 and 2, CAR concentrations (28 and 83%, respectively, compared to the solvent control). The formulation, besides increasing SOD activity (72%), augmented GSH levels by 23% and inhibited CAT activity by 47% (compared to the water control).

Regarding the reproductive endpoints analyzed, no toxic effects were found neither at concentrations as low as 0.1 mg/L nor even at very low toxicant levels. At the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including crinidians, crustaceans, rotifers and echinoderms. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and non, and even environmental matrices such as sediment eluates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed as an ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken in account in ecotoxicological risk assessment.

TU120 Toxicity of lanthanides to freshwater microcrustaceans

M. Baurius, Instituto de Fisica / Department of Materials and Environmental Technology, A. Lukjanova, H. Vija, A. Kahru, I. Blinova, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology

The application of lanthanides (Ln) in different sectors of the world economy has significantly increased during the last two decades. This process has been accompanied by increased releases of Ln into the environment. The anthropogenic anomalies of Ln in soil, surface water, groundwater and even in tap water have already been registered. The disruption of the natural biogeochemical cycle of Ln increases the risk of biota being exposed to elevated concentrations of Ln. However, the ecotoxicological effects of these elements and their fate in the environment are still insufficiently understood. The toxic concentrations reported in the literature, e.g., for Daphnia magna, noticeably vary presumably due to different test conditions. For this study, acute ecotoxicity testing of Lu, Ce, Pr, Nd and Gd nitrates to freshwater crustaceans Daphnia magna (48 h) and Thamnocephalus platyurus (24 h) were performed in synthetic freshwater and natural lake water. Also, long-term (21 days) exposure of D. magna (OECD 211) in lake water was included. It was shown that the Ln fractionation between two main phases (precipitated or settled or remained in the water column) changed during the tests depending on (i) water composition, (ii) nominal concentration, (iii) exposure time, and (iii) tested chemical element. Therefore, nominal concentrations were used for toxicity calculations. Acute toxicity of investigated Ln to both crustaceans was similar (EL50 values for Gd were received from 18.2 to 34.6 mg L⁻¹ for T. platyurus and 18.5-31.1 mg L⁻¹ for D. magna. Gd was the most toxic to both species, however, difference between EL50 values for Gd and other Ln was statistically significant (p < 0.05) only in T. platyurus. In the lake water, bioavailability of Ln was much lower: mortality of exposed organisms did not exceed 23% at the largest tested concentration (50 mg L⁻¹). In contrast to acute assays, the 21 day chronic test performed in the lake showed high Ln toxicity to D. magna (0.2 to 0.5 mg L⁻¹). It was revealed that mortality was a more sensitive endpoint than reproduction. Differences between LC50 of individual Ln were not statistically significant. Thus, our results support the hypothesis that different lanthanides have a similar mechanism of toxicity in crustaceans. This work was supported by Estonian Research Council grant IUT23-5.

TU121 Relevance and suitability of invertebrates swimming behavior as sub-lethal endpoint to be considered for ecotoxicological investigation

s. morgana, V. Piazza, C. Gambardella, E. Costa, F. Garaventa, M. Faimali, CNR/ISMAR

Ecotoxicology is aimed to assess, monitor and predict the effect of contaminants in the environment. Looking for new and alternative approaches in this discipline has become of increasing importance. Furthermore, within the 3Rs approach (reduction, refinement and replacement) the basic idea is to reduce the use of vertebrate organisms and to refine the procedures to minimize pain, suffering, and distress. To achieve this goal, ecotoxicology needs analytical tools to detect ecotoxicological effects even at very low toxicant levels. At the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including crinidians, crustaceans, rotifers and echinoderms. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and non, and even environmental matrices such as sediment eluates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed as an ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken in account in ecotoxicological risk assessment.

TU122 Benefits of Using Ecologically and Economically Valued Invertebrate Species for Ecotoxicological Analyses: Potential Phototoxic Effects Comparing a Freshwater Vertebrate and Invertebrate

E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources; M. Basiri, Louisiana State University / Department of Biochemistry and Molecular Biology / Department of Materials and Environmental Technology, A. Lukjanova, H. Vija, A. Kahru, I. Blinova, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology

The application of lanthanides (Ln) in different sectors of the world economy has significantly increased during the last two decades. This process has been accompanied by increased releases of Ln into the environment. The anthropogenic anomalies of Ln in soil, surface water, groundwater and even in tap water have already been registered. The disruption of the natural biogeochemical cycle of Ln increases the risk of biota being exposed to elevated concentrations of Ln. However, the ecotoxicological effects of these elements and their fate in the environment are still insufficiently understood. The toxic concentrations reported in the literature, e.g., for Daphnia magna, noticeably vary presumably due to different test conditions. For this study, acute ecotoxicity testing of Lu, Ce, Pr, Nd and Gd nitrates to freshwater crustaceans Daphnia magna (48 h) and Thamnocephalus platyurus (24 h) were performed in synthetic freshwater and natural lake water. Also, long-term (21 days) exposure of D. magna (OECD 211) in lake water was included. It was shown that the Ln fractionation between two main phases (precipitated or settled or remained in the water column) changed during the tests depending on (i) water composition, (ii) nominal concentration, (iii) exposure time, and (iii) tested chemical element. Therefore, nominal concentrations were used for toxicity calculations. Acute toxicity of investigated Ln to both crustaceans was similar (EL50 values for Gd were received from 18.2 to 34.6 mg L⁻¹ for T. platyurus and 18.5-31.1 mg L⁻¹ for D. magna. Gd was the most toxic to both species, however, difference between EL50 values for Gd and other Ln was statistically significant (p < 0.05) only in T. platyurus. In the lake water, bioavailability of Ln was much lower: mortality of exposed organisms did not exceed 23% at the largest tested concentration (50 mg L⁻¹). In contrast to acute assays, the 21 day chronic test performed in the lake showed high Ln toxicity to D. magna (0.2 to 0.5 mg L⁻¹). It was revealed that mortality was a more sensitive endpoint than reproduction. Differences between LC50 of individual Ln were not statistically significant. Thus, our results support the hypothesis that different lanthanides have a similar mechanism of toxicity in crustaceans. This work was supported by Estonian Research Council grant IUT23-5.

TU123 Impacts of anti-cancer drugs on freshwater rotifers at environmentally realistic concentrations

N.B. Martins, University of Minho, Department of Biology & CBMA / Department of Biology; A. Pradhan, University of Minho / Department of Biology; F. Cassio,
C. Pascoal, University of Minho / Centre of Molecular and Environmental Biology
CBMA Department of Biology
As human population increases, the presence of emergent chemical contaminants (ECC's) in freshwaters increases. ECCs have shown to be persistent and bio active, reaching the freshwater aquatic systems mostly untreated, where their fate and behavior is little understood. Anti-cancer drugs are among the ECC's of concern due to their high cytotoxicity and increasing usage. The administration of drugs in corals, instead of single drug treatment, make the assessment of the environmental risk of these compounds a difficult task with much information lacking on sub-lethal effects on aquatic species. We used two cytotoxic drugs aiming at linking their effects on the reproduction inhibition of the rotifer *Brachionus calyciflorus* with processes of oxidative stress. The rotifer was exposed to concentrations of 10 μg/L of a antimetabolite (5-Flourouracil, 5FU) and a cytotoxic antibiotic (Doxorubicin; DOX) alone and in mixtures. The results showed that 5-Flourouracil had a stronger effect (EC50=0.074 mg L⁻¹) on the population growth rate than Doxorubicin (EC50=13 mg L⁻¹) and toxicity effects were detected at environmentally relevant concentrations. Two concentrations of each drug were chosen for binary mixtures and two concentrations per drug were used to assess reactive oxygen species (ROS) accumulation and plasma membrane damage with epifluorescence microscopy. In the presence of low concentrations of 5FU, there was a reduction of the toxicity induced by DOX indicating possible antagonistic effects between both drugs. At concentrations, as low as EC50, we found accumulation of ROS in a dose dependent manner showing a clear connection between ROS accumulation and the toxicity of these compounds. Furthermore, this increase in ROS production and cellular effects were found with possible consequences for the community at the long term.

TU124
Development in vitro and in vivo methods of measuring acetylcholinesterase and general esterases in aquatic invertebrates
Y. Cao, University of Copenhagen / Department of Plant and Environmental Sciences; M. Gottardi, University of Copenhagen / Plant and Environmental Sciences; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences
Quantification of acetylcholinesterase (AChE) and other esterase activities are important in terms of assessing the toxic mechanism of organophosphate and carbamate insecticides. There are several techniques for measuring AChE and general esterases (GE) activity involving spectrophotometric or fluorescence detection of transformation products. In this study, we tested four methods to detect AChE and GE activity in vitro and in vivo in the two aquatic invertebrate species: Daphnia magna (water fleas) and *C. riparius* (crayfish). The aim of this comparison was to find the most effective and selective of the four methods, 2) to compare in vitro with in vivo measurements and 3) to compare the inherent esterase activities of *D. magna* and *C. riparius*. The four assays were: 1) AChE-assay using acetylthiocholine iodide (ATCI) as substrate, 5,5'-dithio-bis-(2-nitrobenzoic acid) (DTNB) as chromogen, measuring the production of 5-thio-2-nitrobenzoic acid; 2) AChE-assay using acetylcholine (ACh) as substrate, measuring resorufin production; 3) GE-assay using 1-naphthyl acetate (1-NA) as the substrate, measuring 1-naphthol production and 4) GE-assay using 4-methylumbelliferyl butyrate (4-MUB) as the substrate, measuring 4-methylumbelliferone production. Michaelis-Menten curves were created for all substrates, where it was possible. The results showed that the GE-assay using 4-MUB measured general esterase activities well both in vitro and in vivo. The AChE-assay using ATCI as substrate and measuring resorufin formation could not be used either in vitro or in vivo. The maximal GE-activities in vitro on *D. magna* and *C. riparius* were 345±44 and 151±51 nmol min⁻¹ mg⁻¹ protein, respectively, when using 1-NA and 295±8 and 60±13 when using 4-MUB, hence, showing comparable activities across substrates. Focusing only on AChE-activity in vitro the maximal activities were 13.2±0.3 and 52±3.1 nmol min⁻¹ mg⁻¹ protein in *D. magna* and *C. riparius*, respectively, making *C. riparius* the species with the highest activity. Turning to in vivo measurements, the GE-activities were 49.1±4.9 and 17.4±1.4 nmol min⁻¹ mg⁻¹ protein for *D. magna* and *C. riparius*. The results of GE-assays using 1-NA and 4-MUB are similar. The AChE-assay could not be conducted in vivo. The GE-assays using 4-MUB, however, could be conducted in vitro as well as in vivo. The GE-activity in *D. magna* was higher while the AChE-activity in *D. magna* was lower compared to *C. riparius*.

TU125
Factors influencing bioaccumulation of metals and pollutants in corals
Y. Parenti, Universidade Federal de Santa Catarina / LABCAI Bioquimica; B.N. Siebert, Universidade Federal de Santa Catarina / LABCAI Bioquimica; J.I. Mattos, Universidade Federal de Santa Catarina / NEPAQ, Departamento de Aquicultura; F. Nunes, UFSC / Departamento de Aquicultura; I.M. Martins dos Reis, Labcapi UFSC; G. Toledo e Silva, Universidade Federal de Santa Catarina / LABCAL Bioquimica; B.N. Parenti, Universidade Federal de Santa Catarina / LABCAI Bioquimica; M.N. Siebert, Universidade Federal de Santa Catarina / LABCAI Bioquimica;
Bioaccumulation is the total accumulation of contaminants in and by an organism from all sources and routes of uptake. Bioaccumulation is normally defined as the sum of the mechanisms of bioconcentration (contaminants obtained from water only), and biomagnification (contaminants obtained from food). Corals pose a conundrum to classifying uptake mechanisms, due to their particular growth forms. Biomagnification in corals can occur through both filter and suspension feeding. It is also known that metals in corals will consistently reflect metallic element composition of the water of a particular area – hence, bioconcentration. Other methods of metal uptake are difficult to assign to one of these categories. Metal particles in suspension in the water are trapped by the defensive mucus layer and ingested by the coral colony as ‘food’. This might be seen as biomagnification. However, biomagnification is traditionally associated with trophic transfer through prey items, and thus the term ‘biomagnification’ does not fit this normal description. In this case, we propose that this route of uptake be called ‘particulate vectored accumulation’. Corals can also include other elements into their skeleton lattice by substitution of Ca²⁺ with other divalent metallic elements. ‘Latticite inclusion’ might be an apt novel term for this occurrence. The crystalline structure of the CaCO₃ coral skeleton differs between hard and soft corals, being either aragonite or calcite. Different mechanisms and pathways for different corals might make it difficult to ascribe relative metal contributions (and therefore toxicity) to each of the two symbionts. These potentially different routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

TU126
Survival, metabolic rates and locomotory activities of a groundwater-obligate copepod species under long-term exposures to tetrachloroethylene
T. Di Lorenzo, Instituto of Ecosystem Study of the CNR Firenze; L. Piccini, University of Florence, Department of Earth Sciences; D. Galassi, University of Laquila; G. Messana, Instituto of Ecosystem Study of the CNR; M. Saena, PRIET CONCET, National University of Luján; W.D. Di Marco, CONCET PRIET; PRIET
Tetrachloroethylene (TCE) is a contaminant frequently found in groundwater of industrialized areas worldwide. The degradation of this chlorinated aliphatic hydrocarbon (CAH) is often incomplete in groundwater and takes several decades. Contamination from TCE is considered persistent and difficult to remediate, due to its high density that favors a gravity-driven vertical infiltration into groundwater bodies. Through means of the Water Framework Directive the European Union has demanded Member States to provide TCE threshold values (TV) for assessing groundwater body quality. In Italy, TCE TV is 1.1 mg/L in groundwater bodies. Studies on surface water species have shown that TCE causes oxidative stress in aquatic invertebrate species. However, the survival and effects on metabolic rates and locomotory activities of a groundwater-obligate species has not been investigated to date. More importantly, the 1.1 mg/L TCE may have on groundwater species under chronic exposures is unknown. In this study, we investigated the effect of 1.1 mg/L TCE on survival, oxygen consumption, and locomotory activities of a groundwater-obligate copepod species (*Moraria sp.*) under different time exposures. The species required for the trials were collected in the Antro del Corechia Cave (Tuscany). We measured the individual-based oxygen consumption of this species as a proxy of possible metabolic reactions to long-term (> 4 days) exposures to TCE at 8.0°C, i.e. about the mean annual temperature of groundwater in the cave. To this end, we used a sealed glass microplate equipped with planar oxygen sensor spots with optical isolation glued onto the bottom of 80-μL wells (Loïgé Systems, Denmark) and connected to an oxygen sensor (Oxy340 Sensor Dish Reader, PreSens, Germany). The system allows simultaneous measurement of 2 replicates and 4 controls. Survival and locomotory activity assessments were performed by counting the number of alive individuals and measuring the number of moving animals in 5 mL glass vials each containing 20 individuals.
the cell, they require a multistep metabolic activation by specific enzymes that participate in biotransformation reactions. The aim of this study was to evaluate biochemical and molecular biotransformation responses of the oyster *Crassostrea brasiliana* exposed to pyrene (50 mg L$^{-1}$ and 100 mg L$^{-1}$) and fluorene (100 mg L$^{-1}$ and 200 mg L$^{-1}$), after two time periods of exposure (24 h and 96 h). The half-life times of both PAHs were quantified by fluorescence in the aquaria exposure water and the transcript levels of phase I (CYP1-like, CYP2-like, CYP2A1I and CYP156A1-like) and phase II (GST-like, GSTm-like and SULT-like) biotransformation genes, EROD, GST and GSTM activity, were evaluated in gills. The half-life time of pyrene (100 mg L$^{-1}$ = 2 h and 12 min) in water was lower than fluorene (100 mg L$^{-1}$ = 5 h and 54 min). These results might be related to the higher lipophility of pyrene, facilitating its influx through the plasma membrane into the intracellular spaces, which may result in toxicity. In including other contaminants, which may change the availability of Ti

Biology; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; C. To

Comparing interspecific Artemia responses to chronic zinc exposure A.P. Costa, Marine and Environmental Sciences Centre / Faculty of Sciences and Technology, University of Coimbra; I. Varo, CSIC / Spanish National Research Council / Biology, culture and pathobiology of marine species; M. Martinez Haro, IREC-Instituto de Investigación en Recursos Cien
géticos / Department of Life Sciences; P. Almeida Vinagre, WavEC - Offshore Renewables / Marine Environment and Public Policies; m. sanchez, CSIC / Wetland Ecology

Toxicity of titanium on the mussel *Mytilus galloprovincialis* P. marmoratus, used for the first time as a bioindicator to investigate the toxicological status of a port and an MPA area by the use of a multi biomarker approach, was found to be a good sentinel species to monitoring coastal marine environment.

The impacts caused by the exposure of Ti (II) solutions with the initial concentrations of 5g/L, 50g/L, 100 pg/L of Ti (II). (Biochemical (oxidative stress related biomarkers, metabolic capacity and energy reserves) markers, after 96 hours and 14 days exposure periods, were evaluated. The obtained results revealed significant alterations in contaminated mussels, varying with the concentration and time of exposure. Mussels exposed to Ti presented lower metabolism, represented by lower selecton transport system (ETS) activity, which decreased along exposure time and decreased their motility. The latter results are in agreement with their glycosen (GLY) and protein (PROT) contents. Moreover, contaminated individuals activated their antioxidant defences increasing the activity of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPO) and glutathione S-transferases (GSTs), which still were not enough to prevent cellular damages (revealed by the increased of lipid peroxidation in mussels exposed to Ti).

Promising invertebrate species as model organism in ecotoxicology: *ephyrae* of the jellyfish *Aurelia sp.* and *Sanderia malayensis* E. Costa, C. Gambardella, V. Piazza, CRN ISMAR; S. Lavorato, Cos

Comparing interspecific Artemia responses to chronic zinc exposure A.P. Costa, Marine and Environmental Sciences Centre / Faculty of Sciences and Technology, University of Coimbra; I. Varo, CSIC / Spanish National Research Council / Biology, culture and pathobiology of marine species; M. Martinez Haro, IREC-Instituto de Investigación en Recursos Cien
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values obtained exposing ephyrae jellyfish to different toxic compounds and materials such as nanoparticles and microplastics with those obtained with other marine invertebrates, highlights that ephyrae are an interesting and promising invertebrate model with a very high ecological relevance to be used in ecotoxicological investigations.

TU132
Paracentrotus lividus and Artemia sp.: never too old model organisms to give new end-points
S. Morgana, C. Gambardella, M. Faimali, F. Garaventa, CNR ISMAR
In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental indication of chemical analyses. In environmental risk assessment, in order to fulfill several regulatory requirements, such as the 3R principles (reduction, refinement and replacement), the development of novel approaches to reduce and eventually substitute the use of vertebrate species results to be paramount. Swimming alteration is one of the most frequently used behavioral responses in aquatic ecotoxicology and its evaluation has proved to be a valuable endpoint in ecotoxicological studies with aquatic organisms. Behavioral responses have proven their usefulness in evidencing impacts of chemicals at environmental concentration that do not necessarily cause mortality; therefore, behavioral endpoints are less invasive than traditional acute tests, but still sensitive and more ecological relevant. In this work, we reported a novel research on the use of swimming behavior of two “old” marine model invertebrates in ecotoxicology, the crustacean Artemia sp. and the echinoderms Paracentrotus lividus, to test the possibility of addressing a kind of specific toxicity in aquatic organisms. For this purpose, in order to evaluate a novel endpoint, we optimized and improved an automatic recording system, namely Swimming Behavioral Recorder system (SBR), by developing i) a new swimming speed alteration test using for the first time sea urchin early stages; ii) a new short-term test based on the evaluation of the swimming speed alteration of Artemia nauplii incubated at 39 °C (± 1) for only 6 hours. Thanks to a modern video-based technology, this study provides new perspectives and future applications applied to two well-known marine model invertebrates, regulating market and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU133
Application of sea-urchin embryo test in the effect directed analysis approach for the evaluation of WWTP effluent in an estuarine media
L. Mijangos, University of the Basque Country UPV/EHU / Department of Analytical Chemistry; M. Krauss, T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; H. Ziarrusta, University of the Basque Country UPV/EHU / Department of Analytical Chemistry; M. Olivares, O. Zuloaga, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry; r. beiras, University of Vigo / Toralla marine sciences station (ecimat); A. Prieto, N. Etxebarria, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry
Sequential LC-UV fractionation methodology was extrasted in order to establish the concentration-response model. A Leducor C8 column (21 fractions were collected) and an aminopropyl column (15 fractions) were used to determine the toxic effects after 48 h: the growth rate of the larvae and the rate of skeletal malformation. 6 levels (n=3) of dose-curve were prepared in units of relative enrichment factor (REF), final volume of 3 mL of filtered seawater with 0.1 % of DMSO). Non-target analysis was performed by means of UHPLC-Qactive Plus MS in positive and negative modes with a C18 column. Toxic compounds were identified using MS2 spectrums, Metfrag and Compound Discoverer (Thermo) interfaced to MZmine. Among the collected C8 fractions, only fraction 13th (F13) showed a clear toxicity and, therefore, it was tested separately to establish the concentration-response model. The curve-dose response of the raw sample (EC50= 10 REF and EC20=19 REF) could be explained by the contribution of active F13 (EC50=14 REF and EC20=39 REF). Regarding the chemical analysis, among the final candidate list (20 compounds), mebendazole was confirmed chromatographically with standards. Nevertheless, a sequential fractionation of F13 was also carried out with an aminopropyl column, which showed a different orthogonality compared to C8 column, and the resulting 15 fractions were also submitted for further biosays and data-dependent analysis. Overall, the results of this work suggest the possibility of addressing a kind of specific toxicity in sea-urchin embryos owing to the determination of only one toxic fraction and the contaminants identified in that fraction. Acknowledgement. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. L. Mijangos is grateful to the Basque Government and H. Ziarrusta to the Spanish Ministry for their predoctoral fellowships.

TU134
Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity
S. Lee, Seoul National University / System Toxicology Research Center; M. Cho, Korea Institute of Toxicology; S. Yoon, W. Kim, Korea Institute of Toxicology / System Toxicology Center
Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxygenase pathway. As signaling molecules, they are important for diverse physiological systems such as inflammation, allergy, pregnancy, pain perception and blood pressure control. Therefore, they could be the important target for toxicant drugs such as ibuprofen and aspirin. However, an invertebrate model to evaluate eicosanoid pathway related toxicity has not yet been developed well though similar eicosanoid pathway was expected in invertebrate species. Therefore, the purpose of this study was to identify genetic information of key genes of eicosanoid pathway in Daphnia magna, a widely used invertebrate model, and to evaluate the transcription levels of the genes after the exposure to eicosanoid targeted drugs. To this end, we collected amino acid sequences of eicosanoids from other species and then compared the sequences in water flea genome database. After the BLAST and alignment, the genetic information of 10 key eicosanoid genes, such as pla2, cox, pgd2 and pge2, was identified. After that, Daphnia magna was exposed to the eicosanoid pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetaminophen at 0.25, 2.5 and 25 μM. Then, we analyzed transcription by qPCR system. In this study, we found that the nine of ten genes were expressed by exposure to the eicosanoid targeted drugs in D. magna. We believe that these results partially indicate the plausibility of D. magna as an eicosanoid pathway related toxicity assessment model. Then, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

TU135
Responses to single chemical and pulse exposures of two monophyletic Daphnia species under a multi-generation approach
G. Arañiz, Universidade de Aveiro / Biologia; A.M. Soares, University of Aveiro / department of Biology & CESAM; D.M. Abessa, Universidade Estadual Paulista - UNESP/CLP / Marine Biology and Coastal Management; S. Loureiro, Universidade de Aveiro / Biology
Phytoplankton human activities such as sewage were exposed to environmental contamination (e.g. industries, agriculture). Those contaminants may have continuous or pulse sources and can affect organisms from natural habitats. In different latitudes even phylogenetically close related species may present divergent chemical tolerance. Therefore, it was used in this study the model species from temperate areas Daphnia magna and the tropical species Daphnia similis. Most studies rely on short term acute and chronic tests. To enhance accuracy, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under different dietary exposures (regular and restricted) and, regarding chemical mixtures of natural environments, pulse exposures (on Pb acclimated daphnids) to the fungicide mancozeb were also accomplished. Organisms from F6 were changed to a clean media for recovery for three generations. To monitor acclimation, standard acute immobilization tests to K+ (0) - (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ tolerance, neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, except D. similis from recovery period under food restriction. However, Pb tolerance increase is seen on both species. Regarding mancozeb exposure (Pb acclimated), no difference between treatments is seen under regular food. However, opposite outcomes are shown under food restriction, such as D. magna increasing and D. similis decreasing tolerance to mancozeb. Adverse outcomes regarding recovery was shown, D. magna relied on genetic adaptation, since it kept a higher tolerance to Pb, even after three generations under recovery, and D. similis relied on physiological acclimation, being similar to organisms from control treatment. Food restriction also decreased reproduction and increased neonates’ body length (both species). The opposite outcomes under food restriction is crucial regarding natural environments and the natural fluctuating amount of nutrients. Therefore, results indicate that daphnids are capable of acquiring resistance to Pb under a long-term exposure, being an essential data on chemical mixtures contaminated habitats, since their tolerance to other chemicals can be as well as used for other chemicals. And also, opposite outcomes regarding monophyletic species indicates that it is not accurate to use species from different climates to estimate toxicity.

TU136
Chronic effects of BPA, BPS, and BPSIP in Daphnia magna
Y. Hong, B. Jeon, I. Ryoo, J. Lee, K. Ji, Yongin University
Since bisphenol A (BPA) can act as a weak estrogen agonist and disrupt steroidogenesis, concerns on adverse health effects are increasing. In response to the regulatory pressures to eliminate BPA in plastics, bisphenol S (BPS) and
4-hydroxyphenyl 4-isopropoxyphenylsulfone (BPSIP) have been frequently used in manufacture of thermal paper and plastic containers. However, there is paucity of information on their chronic toxicity using aquatic invertebrates. In the present study, chronic toxicity of BPA, BPS, and BPSIP were evaluated using Daphnia magna in accordance with OECD Test Guideline 211. The endpoints for the long-term exposure were survival, reproduction, and growth. Compared to the control group, the body length was significantly decreased in D. magna exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<0.05). The results showed that BPA, BPS, and BPSIP could induce endocrine disruption related to the growth in aquatic invertebrates, and the effective concentration of BPSIP was similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appeared to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).

TU137 Oxidative effects of mono-(2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level Y. Kele, KIST Environment Safety Group; Y. Seol, KIST-Europe / Environment Safety group Mono-(2-ethylhexyl)-phthalate (MEHP) is the metabolite of di-(2-ethylhexyl)-phthalate (DEHP), which is widely used in the industry as plasticizers. According to previous studies, DEHP inhibits molting hormone. In addition, MEHP is highly persistent and bioaccumulative in environment and living organisms. In EU Regulation 2013/571/UE on phthalates of MEHP acts as a mimic disrupting chemical in aquatic organism such as Daphnia Magna. The aim of this study was to elucidate the linkages between toxicity test result and oxidative stress of MEHP. We studied the effects of oxidative stress as molecular initiating events on Daphnia magna. We observed the changes in different levels of the lipid peroxidation, glutathione S-transferases (GSTs), catalase (CAT) and superoxide dismutase (SOD) in the treated daphnids. This study showed the molting rate, reproduction rate and growth of daphnids during chronic (21 d) test in order to link the activities of reproduction system to antioxidant responses. Further study is needed to clarify how MEHP leads to dysfunction of endocrine system of Daphnia magna.

TU138 Are Daphnia magna and Chironomus riparius acute responses comparable? B. Ponti, ChemService Srl; R. Bettinetti, University of Insbruck / DSTA; D. Garagna, ChemService s.r.l.; F. Casarotto, University of Insbruck; M. Neri, ChemService srl - Controllo e Ricerche Laboratory ecotoxicity test results predict the responses of organisms with varying degrees of accuracy. Traditionally, the acute toxicity on aquatic invertebrates is estimated by exposing for 48 hours young cladocerans of Daphnia magna (OECD test guideline n. 202, 2004), taking advantage of its well-experienced sensitivity and reliability for a huge number of known and unknown toxicants. The 48 hours test on Daphnia magna conducted according to OECD 202 is listed as a data requirement. EU Regulation 2008/98/EC on pivotal test of MEHP acts as a mimic disrupting chemical in aquatic organism such as Daphnia Magna. However, there is paucity of information of similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appeared to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius M. B. Cordale, University of Aveiro; A. Rodrigues, University of Aveiro / Biology Department and CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Pestana, CESAM & University of Aveiro / Biology Natural populations are constantly facing large array of environmental stressors, from both natural and anthropogenic origin, which represent a strong selective force shaping the behaviour, physiology and morphology of organisms. Genetic diversity acts as a key component of adaptation to environmental stressors and their potential to adapt to changing environmental conditions. Ecological risk assessment needs to couple quantitative genetic analysis with ecotoxicological studies in order to understand the mechanisms underlying evolution of tolerance. Research on genetic variation regarding tolerance to contaminants has been mostly performed with clonal lineages. An alternative methodology has been applied for sexually reproducing organisms, focusing on sensitivity to mixtures of contaminants (toxicogenotypes) and estimating genetic variation in fitness traits. However, additional environmental stressors are not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-sib family split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (microbial insecticide exposure under two levels of salinity). Each egg mass was considered a single family (full-sib genotype). Within each family, larvae were randomly allocated to all treatments. Emergence rate, time to reach the fourth larval stage, and survival rate were used as response variables. Relationships between genetic variation, life-history traits and fitness costs in response to microbial insecticides, and the potential of a key aquatic insect species to evolve tolerance to these compounds will be discussed as well as an evolution of disease resistance on aquatic species. The study also highlights the suitability of C. riparius, a model organism in aquatic toxicology, for quantitative genetic analyses.

TU141 Effects of Amitraz on Chironomus riparius: life history and biochemical responses H. R. Monteiro, University of Aveiro / Department of Biology and CESAM; J. P. Sousa, University of Aveiro / Biology & CESAM & University of Aveiro / Biology & CESAM; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; M. F. Lemos, Instituto Politécnico de Leiria / MARE IPILeiria Amitraz is a very effective formamidine insecticide used in agriculture to control fleas. Amitraz affects the central nervous system, immune response, stress response, detoxification mechanisms and apoptosis among others. A Amitraz is as plasticizer used in packaging and other industrial products with confirmed endocrine disruption activity. In this study we have used two common UV filters, octocrylene (OC) and 2-ethylhexyl-4-dimethylaminobenzozate (OD-PABA), and BPA to mimic the negative impacts resulting from PCP and interactions with plastic of PCP containers. These mixtures were used to study the relationship between the biota of freshwater ecosystem and the main objective was studying the effects that the mixtures can have on an insect with a role in the food chain of these ecosystems, Chironomus riparius. C. riparius is a dipteran with aquatic larvae frequently used in toxicity tests. Fourth instar larvae were exposed for 24 hours to single compounds and to binary and ternary mixtures. Effects of Amitraz on Chironomus riparius was also studied by retrotranscription and Real-Time PCR using a specific array covering a number of relevant metabolic pathways like endocrine system, immune response, stress response, detoxification mechanisms and apoptosis among others. Using an array could improve the toxicological evaluation of the cellular effects of the compounds favoring the identification of new molecular biomarkers useful for ecological risk assessment and toxicity tests. The methodology used to design the array can be used with other species improving also our knowledge about the mode of action of these compounds. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CTM2015-64913-R, and the European Union’s Horizon 2020 research and innovation program (Project H2020-MSCA-RISE-2015F).
the most sensible endpoint (LOEC of 40 µg L⁻¹). Short-term exposures (48 h; 0, 10, 40, and 160 µg L⁻¹) to amitraz induced glutathione peroxidase activity and a decrease in catalase activity. Additionally, amitraz exposure caused a decrease in lactate dehydrogenase activity and a significant increase in electron transport system activity, both energy metabolism associated biomarkers. Regarding oxidative damage biomarkers, lipid peroxidation increased in C. riparius larvae exposed to 100 µg L⁻¹ amitraz, while there was a significant decrease in DNA damage levels at 10 and 40 µg L⁻¹ treatments. These results reveal possible biochemical targets of amitraz toxicity and suborganismal responses associated with amitraz exposure. The assessment of biochemical biomarkers may support the interpretation of toxic responses observed at organism level and therefore in the assessment of the ecological effects of environmental contamination. Moreover, it increases the information available on the outcomes of amitraz exposure in freshwater invertebrates, and underlines the importance of risk assessment studies of formamidine pesticides. Acknowledgements: This study had the support of the Fundação para a Ciência e a Tecnologia through project PROTEOME (PTDC/AAG-MAM/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-016773).

TU142
Multigenerational exposure of Folsomia candida to copper agrochemicals: conventional and nano-pesticides
C. Malheiro, Department of Biology, University of Aveiro / Biology; A.R. Silva, University of Aveiro / Dept.of Biology & CESAM; D. Nunes Cardoso, CESAM; U.N. Pires, A.M. Soares, University of Aveiro / department of Biology & CESAM; L.P. Figueiredo, Department of Biological Sciences; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology
Agricultural practices include the use of agrochemicals for crop maintenance and enhanced productivity. Although soil contamination may result in long-term effects, agrochemicals, like copper pesticides, have been used in a range of agricultural applications, which may result in environmental problems. More recently, nanopesticides were introduced in the market with the intent to improve efficacy and decrease environmental negative effects. However, the chronic ecotoxicological effects of nanoparticle exposure on soil biota are not well known since related environmental hazards are most often assessed using only the active ingredients. Moreover, the multigenerational effects of long-term, chronic exposure of soil organisms to agrochemical applications are unknown. The objective of this study was to evaluate the impact of long-term, multigenerational exposure of the soil collembola Folsomia candida to conventional and nanoparticle formulations of copper pesticides. Two formulations were assessed: Kocide® 3000 (nano form) and Champion® WP (conventional), as well as the pure active ingredient Cu(OH)₂ in spiked LUFA 2.2 soil. The effects of multigeneration exposure to the Cu pesticides were assessed using two soil treatments: 1) Cu spiking performed only at the beginning of the experiment and collembolan responses (survivability, reproduction) measured for three generations (i.e., aging soil exposure); and, 2) Cu spiking performed at the start of each new cohort (three generations i.e., renewal soil exposure). After three generations in both soil treatments, the surviving collembola were moved to uncontaminated soil for three generations to assess their recovery potential. Similar response patterns were observed in the two soil treatments for all three Cu formulations. Exposure to aging soils revealed an increasing tolerance across generations of F. candida. In contrast, in treatments with renewed Cu spiking, the collembolan populations showed ongoing sensitivity to Cu exposure. In both treatments, after being moved to clean soil, all treatment populations showed some recovery by displaying increased reproductive output. Copper forms presented different behavior between them in the long term exposure. This study further emphasizes the importance of using multigenerational approaches to obtain more ecological relevant evaluations of environmental risk associated with chronic exposure to soil agrochemicals.

TU143
Effects of multiple environmental stressors on Eisenia fetida coelomocytes: cell viability and different behaviour of amoebocytes and eleocytes
N. de Sousa, University of the Basque Country / Zoology and Animal Cell Biology; Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU; E. Urionabarrenetxea, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology; M. Soto, University of the Basque Country / Zoology and Animal Cell Biology. Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU. Earthworm immune cells (coelomocytes) have become a target system in ecotoxicology due to their sensitivity against a wide range of pollutants. Moreover, endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at longer exposure times and higher complexity levels (organism, population). Since soils are subjected to multiple environmental stressors (i.e., temperature increases, acidification, organic matter depletion, new pollutants) it is of great interest to assess how those stress scenarios pose changes in earthworms at cellular level. Coelomocytes compose a heterogeneous cellular group where two major cell subpopulations are distinguished, amoebocytes and eleocytes. However, the behaviour of those subpopulations against different stressors is still unclear. Hence, the aim of the present work was to address the effects of different stressors (increase in temperature, low OM, model and emerging –nanoparticles- contaminants) on E. fetida coelomocytes by assessing mortality and changes in the relative proportion of subpopulations (amoebocytes, eleocytes). For that, earthworms were maintained under low OM content (6% vs. 10%), thermal stress (19°C vs 26°C) and after one month conditions (Cd: 5.25 mg kg⁻¹, Ag NPs: 0-100 mg kg⁻¹) in OECD soil during 3 days. After exposure of earthworms, coelomocytes were retrieved and viability was assessed in microplate through Calcein AM assay. In addition, flow cytometry analysis was used to determine mortality of coelomocytes and changes in the relative proportion amoebocytes/eleocytes. Coelomocytes extruded from earthworms maintained under low OM condition showed a significant decrease in cell viability, but no changes were recorded in the relative proportion of amoebocytes and eleocytes. Exposure to Cd provoked higher mortality in eleocytes while Ag NPs caused more mortality in amoebocytes. Thus, we can conclude that the response of the different subpopulations was dependant on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential of earthworms as sentinel organisms for an accurate soil health assessment in a global warming scenario. Acknowledgements: Basque Gov (IT10-13), Univ. Basque Country (UIF 11/37) and MINECO (Nanosilveromics Proj).

TU144
Toxicity of abamectin and difenoconazole, pure and formulated, to Folsomia candida
L.P. Figueiredo, University of São Paulo USP; G. Mainardi, Vrije Universiteit / Department of Ecological Science; C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science; D. Rodolf, Vrije Universiteit / Department of Ecological Science
The progressive increase in the use of pesticides has been accompanied by effects at different levels of biological organization, implying losses of species and consequently of ecosystem services. Among the species utilized in terrestrial ecotoxicological tests, the springtail Folsomia candida (Collembola, Isotomidae) is one of the species suitable for assessing side-effects of hazardous soil arthropods. In Brazil, the acaricide abamectine and the insecticide difenoconazole are widely used in agriculture, but little data is available about their possible side effects on the soil community. The objective of this work therefore was to evaluate the effect of abamectine, pure and in the formulation Kraft®, and of difenoconazole, pure and in the formulation Score®, on the reproduction of F. candida using a standard Lufa 2.2 soil. Juvenile F. candida, with age 10-12 d., were exposed following the standardized ISO and OECD test guidelines. The results were analyzed by analysis of variance (ANOVA) followed by Dunnett’s test at 5% significance level. Median lethal concentration (LC₅₀) was calculated using Trimmed Spearman Karber (TSK) and EC₅₀ and EC₇₀ values for effects on reproduction were estimated using a logistic model. The results showed that both pesticides were more toxic in the formulation than when applied as pure active ingredient. For abamectin dosed as the formulation Kraft® EC₅₀ was 1.0 (0.17-1.8) mg/kg dry soil, while it was 6.3 (1.8-11) mg/kg dry soil for the pure active ingredient. For difenoconazole applied as the formulation Score®, EC₅₀ was 53.5 (40.0-67.0) mg/kg dry soil while no effects on springtail reproduction were seen at concentrations of the pure active ingredient up to 333 mg/kg dry soil. The data indicate that it is essentially the formulation that is responsible for the results with the test active ingredients. It is currently unknown which component of the formulation causes the increased toxicity. Therefore, we are applying gene expression analyses to mechanistically underpin increased toxicity levels caused by the tested formulations.

TU145
Terrestrial arthropods as indicators of environmental pollution
V. Lesch, North-West University; H. Bouwman, North-West University / Unit for Environmental Science and Management
In recent years, the use of and interest in terrestrial arthropods as indicators of environmental contamination has increased. Arthropods are one of the most species rich components of terrestrial ecosystems, with over 1 million species described. Terrestrial arthropods are relatively easy to sample, and collection normally has less ethical restrictions than for higher animals. We reviewed the literature. We found relatively few general studies on arthropods as indicators of environmental pollution. However, those that did worked on spiders, bees, earthworms and ants. In addition, most studies favoured predatory species, since they are more representative for the impact of contaminants on the food web and demonstrates the importance of arthropods in and around the area. In most studies, the sampling sites were close to old mines, or the studies are restricted to one or two arthropod species. In our study, we compared arthropods from different locations. Published literature on terrestrial arthropods not only focuses on whole body utilisation but also organ specific studies, as well as research on the use of arthropod products (such as honey and spider webs) as matrices for analyses. Most arthropods have a close association with soil, foliage, and air, representing pollution concentrations in the immediate environment. Each arthropod species occupy a unique niche and in doing so represent the concentration or degree of pollution in different ways. Each species, therefore, indicates pollution from different perspectives. However, there is still a
The impact of chlorpyrifos and its formulations on the acetylcholinesterase activity in non-target soil organisms

TU146
Spray drift of pesticides has a negative impact on aquatic ecosystems and the environment, including damage to non-target organisms. Particularly, the drift of some insecticides can have detrimental effects on beneficial arthropods such as predatory mites. According to a recent EU Directive, the reduction of spray drift is required for a sustainable use of pesticides, yet without reduction of efficacy against pests. In this framework, eight field trials were conducted from 2012 to 2014 in two typical growing areas of Verona district (Northern Italy), four on apple orchards and four on vineyards. The aim of these trials was to evaluate, for two spray drift reduction techniques: 1) the spatial patterns of in-field droplets, 2) the efficacy agrochemicals in organic farming (Coppola pomace and Lobesia botrana respectively), and 3) the side effects on predatory mite populations. Four insecticides, chlorpyrifos, chlorpyrifos-methyl, methoxyfenozide and spinetoram, were applied with three different spraying techniques: high-drift nozzles (Albu, ATR 80), low-drift nozzles (Albu, TVI 80001 green), and high-drift nozzles with an anti-drift adjuvant (rapeseed oil). Results showed that the two spray drift reduction techniques effectively increased droplets amounts next to sprayer, reducing potential drift on both apple orchards and vineyards and were generally as effective as standard nozzles without additional side effects on beneficial arthropods. Results suggest that the use of spray drift reduction techniques such as low-drift nozzles and anti-drift adjuvants can be effective in managing key pests and also in decreasing the environmental impact of using insecticides. Full article in: Crop Protection 98 (2017) 283-292, DOI:10.1016/j.cropro.2017.04.010.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (P)

TU149
Freshwater organism can recognize microplastics as microplastics S. Kim, Y. Chae, D. Kim, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science
The plastics are slowly weathered into nano- (<100 nm) and micro- (<5 mm) sized particles owing to physical, chemical, and biological processes in the environment. In this study, we observed the behaviour of freshwater organisms and evaluated whether they recognize and respond to microplastics. Adult zebrafish was exposed to the different concentration of microplastic (MP, 250-300 μm) and food materials (F) (20 mg MP, 20 mg F; 20 mg MP + 10 mg F, MP10F10). The behaviour patterns were recorded and quantified. Diving beetle fed the adult zebrafish, which exposed under MP10F10 and F20 conditions, and the ingestion rate was quantified. The number of capturing patterns were counted as 0.0±0.0, 2.8±1.3, and 0.2±0.4, respectively. Ingestion rate of diving beetle on control group was calculated as 0.63±0.10 zebrasfish wet/sect. The exposure group, which fed the MP10F10 exposed zebrasfish, showed the significant decreasing (< 0.05) of ingestion rate (0.55±0.08 zebrasfish wet/sect) during 591±85 seconds. On diving beetle, the MP were fully caught until 720 min after ingestion, and did not transfer to another organ. The digestive organs, especially crop, seemed to separate the microplastic as indigestible food. We concluded that the freshwater organisms recognize the microplastic, and exhibit the defence behaviour. This research was supported by Basic Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).

TU150
Microplastic shedding from functional textiles C. Jonsson, Swerea IVF AB / Swedish Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); P. Melin, Swerea KIMAB AB; O. Levenstam, University of Borås; A. Hanning, Swerea IVF AB; S. Roos, Swerea IVF AB / Energy and Environment
Microplastic pollution of marine environment is an environmental issue which is intensively discussed on a global level. Synthetic based textiles contribute to microplastic pollution of the marine environment. Besides littering and the size-shape effects that microplastics have when being exposed to humans and animals they provide an additional vector for chemical pollutants, i.e. possibly providing a new entering mode into organisms of pollutants already existing in the sea. But fibers generated from consumer articles such as textile garments might carry chemical pollutants due to different chemical treatments. This study investigated if PAOs and polyamide/cotton blends (PES/CO) textiles that were functionalised with durable water repellent (DWR) treatment. The chemical treatment consists of polymers that are based on per- and polyfluoralkyl substances (PFAS). Question 1: Do we have release of fluorinated fibers from functional textiles? Question 2: What is the amount of fluorinated fibers lost during the washing which can have an impact on the environment? The microscopic investigation identified if the fibre fragments were generated during the simulation of industrial washing (Gyro wash). Fiber fragments were identified with REM and the EDX analysis of showed fluorine (F) as part of the fibre surface.
composition. The results will be further verified using combustion ion chromatography (CIC) of shedded fibers with and without DWR treatment. These results will then be used to model a scenario simulating for instance Swedish consumption and use of DWR treated outdoor garments and the total exposure of fluorine contaminated fibers to the environment, from washing via waste water treatment to the recipient. This study proved that functional textiles can contribute to the release of microplastic pollution due to the formation of synthetic fiber fragments during a polymerization reaction. The detection of the fiber size and composition confirmed that these fibers still contained traces of the functional DWR treatment. Released into the environment these fibers might be exposed to long term degradation processes which would finally cause the formation of persistent environmental pollutants. In addition the results of this study suggest that similar mechanism might be relevant for textile containing other functional coatings such as flame retardants, softeners or dyes as well.

TU151

Fate of 14C-labelled Calcium Poly(styrene sulphonate) (CaPSS) Microplastic in waste water treatment at environmentally relevant concentrations


Wastewater is one of the exposure pathways of microplastic into the environment. Microplastic enters the wastewater e.g. as an ingredient of cosmetics or from specific pharmaceutical applications. Wastewater treatment plants (WWTPs) are generally considered to remove microplastic from the wastewater stream and to protect the receiving river. However, there is not much information to prove this assumption experimentally at environmentally relevant concentrations. This is due to the fact that so far no methods are available to analyze organic polymers in a complex sludge matrix at such low concentrations. In view of these limitations, the aim of this work was to determine the fate of a model polymer, crosslinked polystyrene sulfonate (PSS), in a simulated WWTP using radiolabeled material. PSS is a polymer which is widely used as an ion exchange resin in various applications. The polymer is insoluble in water and is not degraded in the human body. Calcium loaded PSS (CaPSS) was synthesized in a procedure downscaled from an industrial method with 14C-labeled calcium styrene monomer. This is a key step in the entire project as the radioactivity of the monomer interferes with the polymerization reaction. The resulting 14C-polymer was characterized by comparison with commercial non-labeled CaPSS to prove success. The 14C-polymers were detected in sludge matrices as well as the sludge incineration of potential water soluble degradation products and 14CO2 from mineralization. A mass balance was established to identify the most relevant processes for the fate of CaPSS in WWTPs. Due to the high sensitivity of 14C-detection, the test can be performed at realistic/environmentally relevant concentrations. As the detection limit of 1C-microplastic in environmental matrices is currently orders of magnitude lower than of microplastic particles, this method can serve as an example how future studies on the general topic “microplastics in the environment” can be supported.

TU152

Microplastics in the environment: Evaluating the risks and identifying knowledge gaps

E.E. Burns, University of York / Chemistry; A. Boxall, University of York / Environment Department

The past ten years has seen increasing scientific and public concern over the harmful effects of microplastics (MPs) in the natural environment. In 2010, < 10 scientific publications contained the word ‘microplastic’ while this number had risen to around 170 in 2016. Alongside this, there have been significant policy and regulatory developments around the use and emissions of MPs. We present the results from a systematic review of the published literature to attempt to answer the question ‘what is the evidence that microplastics adversely impact freshwater and marine systems?’ In answering this question, we explore the evidence-base for a number of impacts and detection in sludge matrices as well as the sludge incineration of water soluble degradation products and CO2 from mineralization. We have summarized the global coverage of microplastic occurrence studies in both aquatic and sediment compartments. We found that many of the occurrence studies employ unsuitable analytical confirmation methods which may lead to high error rates and limit data interpretation. In many ecotoxicology studies, effects were not seen at the highest concentrations investigated while others reported impacts at much lower concentrations (fossil endmember systems, growth, tissue inflammation and mortality. Studies have also assessed the potential for MPs to act as a vector for hydrophobic organic compounds to accumulate in organisms. No conclusive evidence was found in the literature to support this theory, instead most studies exploring this effect disproved the hypothesis while a few are inconclusive due to flaws in the experimental design and interpretation. Comparison of monitoring and effects data indicates that concentrations of MPs currently detected in the environment are orders of magnitude lower than those where effects/no-effects are observed in the laboratory. Moreover, enough ecotoxicity data is now available to begin building species sensitivity distributions.

We demonstrate that based on current data concentrations of MPs measured in the environment are not high enough to elicit the effects reported from laboratory studies. There is however a mismatch between the size ranges and types of MPs used in laboratory ecotoxicity tests and those detected in the environment. There is an urgent need to address this mismatch by performing better quality and more holistic monitoring studies alongside environmentally relevant effects studies. Only then will we be able to determine whether these materials are having real impacts or not.

TU153

A cost-effective methodology for separation of microplastics from freshwater systems

M. Rodriguez, Department of Biology & CESAM - University of Aveiro / Department of Biology; F. Goncalves, University of Aveiro / Department of Biology and CESAM; H. Nogueira, Universidade de Aveiro / Department of Chemistry; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; A.M. Goncalves, MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University; N. Abrantes, University of Aveiro / CESAM; M. O. Rodrigues, Department of Biology & CESAM

Microplastics, one of the most demand material worldwide, are considered one of the most emerging aquatic contaminants due to their ubiquity, high persistence and insufficient management. Especially, microplastics (< 5 mm) are of scientific and social apprehension as they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. Currently, the concerning about the occurrence of microplastics (MPs) in freshwater systems has been increasing, notwithstanding there is no unified method for MPs separation in these systems. This result in inaccuracy data that differs in quality and resolution, not allowing data comparison between different studies (large-scale spatial and temporal comparisons). Hence, this work aims to assess the effectiveness of distinct separation methods as an attempt to identify and establish the most cost-effective method. For that, artificial samples containing eleven plastics belonging to the most common types of polymers (e.g. low/high-density polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyethylene terephthalate) were prepared (secondary MPs) and subjected to distinct methods. These methods included density separation methods using sugar, olive oil and zinc chloride, as well as organic matter degradation methods using hydrogen peroxide (peroxo oxidation) and multienzymatic detergent (enzymatic digestion). The samples were then undergoing the detection, quantification and identification of polymers using a dissection microscope and Fourier transform infrared spectroscopy (FTIR). Several criteria were considered in order to achieve the aims of this work: efficiency of density separation and organic matter degradation, the total mass of recovered MPs, the cost of each method, the simplicity and the quality of recovered polymers. Based on this multi-criteria approach, this study concludes that the wet peroxide oxidation with addition of zinc chloride was the most cost-effective method. This method should be used in future studies of monitoring of MPs in aquatic systems, notwithstanding the use of hydrogen peroxide must be cautious and only applied when necessary.

TU154

Applicability of remote sensing methods for indirect mapping of microplastic distribution within aquatic ecosystems

S. Pehl, University of Bayreuth / Department of Animal Ecology I; E.C. Atwood, RSS Remote Sensing Solutions GmbH; M. Bochow, Helmholtz Centre Potsdam GH; German Research Centre for Geosciences; E. Siegert, RSS Remote Sensing Solutions GmbH; F. Siegert, Ludwig Maximilians University of Munich / Department of Biology; C. Laforsch, University of Bayreuth

Recently, there have been intensified research efforts to get reliable information about sources, sinks, and transportation pathways of microplastic in aquatic environments. Due to the high spatiotemporal variability of these systems, our knowledge of those aspects is still limited. Earth remote sensing is a key technology within the field of environmental monitoring, providing a unique tool for large area observations of water parameters such as suspended particulate matter, chlorophyll-a or colored dissolved organic matter. Since floating microplastic is probably influenced by the same transport mechanisms as non-motile plankton or macrophytes, we tested the hypothesis of a correlation between microplastic and specific water parameters. In situ water parameters, microplastic (5nm – 250um), and in situ derived spectral reflectance measurements (ASD FieldSpec) were taken during field campaigns at three different river mouths (Trave and Elbe in Germany, Po in Italy). Microplastics from surface waters were sampled with a manta trawl. Organic material was removed by enzymatic digestion and wet oxidation, and the remaining microplastics were analyzed down to plastic type with FT-IR as well as SWIR spectroscopy. Initial regression analysis results comparing microplastic with water parameters will be presented, and their suitability as indicators for microplastic abundance is discussed. Furthermore, simultaneously obtained remote sensing data for the river Elbe will be linked in situ derived microplastic data and water parameters. If significant relationships between microplastic and water parameters exist, remote sensing of water parameters as an indicator for microplastic abundance would provide a cost-effective monitoring tool, able to cover much larger areas than feasible with ship-based point measurement.
Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ samples and ocean current modelling

E.C. Arwood, RSS Remote Sensing Solutions GmbH; F.M. Falcieri, CNR - ISS; S. Piel, University of Osnabrueck / Institute of Environmental Research; I. M. Bochow, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; M. Matthies, University of Osnabrueck / Institute of Environmental Research; J. Franke, RSS Remote Sensing Solutions GmbH; S. Carniel, M. Sclavo, CNR - ISMAR; C. Laforsch, University of Bayreuth; F. Siegert, RSS Remote Sensing Solutions GmbH.

Plastic pollution in inland waters and the open ocean is a long recognized problem for marine wildlife, coral reefs, the fishing industry and shipping transport safety. Microplastics, defined as particles < 5 mm, form a considerable portion of this pollution and have recently received increased public attention following recent discoveries that not only can these particles be ingested by planktonic animals, but also outnumber natural food items in some ocean areas. Ingested particles can induce negative survival effects as well as serve as introduction vectors for accumulated persistent organic pollutants (POPs) or carcinogenic plastic additives into the base of the food chain, potentially leading to many seafood products consumed by humans. Research has mainly concentrated on marine systems, and while a growing number of studies focus on freshwater lakes, river systems have to date received little attention. In particular, riverine plumes as an important influencing factor for the input and distribution of microplastics into coastal ocean areas remain largely unexplored. Here we present a study of the accumulation of microplastic particles emitted by the Po River along the Adriatic coastline in northern Italy. We posit that river-induced coastal microplastic accumulation can be predicted using a hydrodynamic model, supported by remote sensing data from Landsat and Sentinel-2A. Model accumulation maps were validated against in situ samples at 9 beach sites (particle size range: 1-5 mm). Hydrodynamic modelling suggests that the amount of discharged particles is only semi-coupled to beaching rates. Object tracking revealed that beaching of emitted particles was strongly mouth dependent and relatively low (less than 25% of all released particles from a given river mouth), primarily occurring within the first five days. The southernmost Po River mouth posed an exception, where more released particles (94%) were found to beach over an extended period of time and along a longer stretch of coastline. Comparison with remote sensing based accumulation maps and validation against in situ beach sampling are discussed. The presented methodology lays the groundwork for developing an operational monitoring system to assess microplastic pollution being emitted by a major river and its distribution along adjacent coastlines as well as into the open ocean.

Cause and effect of the plastic industry in South Africa as a developing country

C. Verster, North-West University - School of Biological Sciences / Environmental Sciences and Development.

In 2017, the South African plastic industry has grown with 1.9%, compared with 2016 (Plastics SA). Although legislation is in place to promote recycling and sustainable use of natural resources, the recycling of plastic based materials is done predominantly by corporate initiative. Many South Africans believe that the country is lagging in terms of recycling. South Africa has however achieved a recycling rate of 41.8% in 2016, of which most is done post-consumer. Plastics SA has set an ideal of no plastics to landfills by 2030, and plans are being set in place to achieve this goal. Inadequate waste disposal infrastructure and protocols, especially in informal settlements causes large quantities of unrecycled plastic to end up in aquatic systems and subsequently in the marine environment. Beaches surrounding estuaries are heavily polluted with macroplastics which calls for greater prevention and clean-up efforts. Much effort is spent corporately to reduce South Africa’s ‘plastic footprint’, but efforts in terms of microplastics are trailing. We collected and filtered 46 fresh water samples from various localities in and around Gauteng, the most densely populated province in South Africa. High levels of plastic pollution were found in almost all samples. Up to 40 plastic particles (> 20 µm) per litre were found in surface water of the Vaal River, a major river in the country’s largest drainage basin flowing through industrialised areas. These levels are comparable to high levels of microplastic pollution found in European rivers. The growing plastics industry in South Africa requires excellence in clean-up and recycling to reduce the negative impacts on the environment and create a viable plastic sector.

Understanding the distribution and fate of microplastics in a tertiary sewage treatment plant in the UK

R.M. Blair, S. Waldron, University of Glasgow; C. Gauchotte-Lindsay, University of Glasgow / Infrastructure and Environment; V. Phoenix, University of Strathclyde / Civil and Environmental Engineering.

Microplastics (MPs; < 0.5 mm) are classified as contaminants of emerging concern but currently are not regulated by water quality standards. Microplastics are highly diverse and their distribution in the environment is highly variable in space and time, making their quantification and risk assessment difficult. Further, their monitoring and regulation are hindered by limited empirical data, particularly of fresh- and wastewater systems as important pathways of land-based contaminants to oceans. Here, a study was conducted in a tertiary sewage treatment plant in the UK (Glasgow, Scotland) to assess the presence of MPs in the system and the effect of treatment stage in removing these contaminants before discharge into recipient environments. The MPs were extracted from five sampling points for the treatment stage, using H2O2 digestion and vacuum filtration through 1.2 µm GF filter. Characterisation and quantification of MPs were carried out by light microscopy followed by detailed chemical analysis of representative subsamples via SEM-EDS and FTIR-ATR. Microplastics were present in wastewater samples collected at all treatment stages, and abundances generally decreased from inflow to outflow. Further, high variability in abundance was evident across sampling dates. Chemical characterisation by SEM-EDS revealed that 94% of analysed pieces were C-based materials, but only 25% were confirmed plastics based on FTIR-ATR results. In conclusion, the tertiary treatment process evaluated here efficiently removes MPs entering the system but small quantities may still be discharged into the environment. Further, visual characterisation with light microscopy may result in overestimation of MPs due to misidentification of cellulose and other non-plastic microdebris as plastics. Therefore, analysis of chemical composition through a combination of detailed analytical techniques is crucial for improved accuracy of results. This study contributes to understanding what methods are needed to extract and identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

Weathering-induced changes in the effects of microplastic particles and their leachates

A. Jalbael, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Technology; C.D. Runmel, Helmholtz Centre for Environmental Research GmbH - UFZ / Department of Bioanalytical Ecotoxicology; D. Kühnel, Helmholtz-Centre for Environmental Research / Bioanalytical Ecotoxicology; M. Schmitt-Jansen, UFZ – Helmholtz Centre for Environmental Research / Bioanalytical Ecotoxicology; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; M. MacLeod, Stockholm University / Department of Environmental Science and Analytical Chemistry.

Studies on the potential effects of microplastic (MP) particles in the aquatic environment are numerous. However, many laboratory studies apply spherical, pristine particles, which may be of limited relevance given UV light irradiation, mechanical stress, salinity, biofilm growth and other factors that can influence the weathering of the particles as well as the ecosystem. The oceans-funded project WEATHER-MIC is to assess the impacts that weathering has on the transport, fate and effects of MP particles and their leachates. We summarize recent results on potential effects. (1.) Impact of MP particles on organisms: We have exposed copepods, daphnia and algae to different fractions of virgin and weathered MP as well as particle-free leachates under controlled conditions. From the observation of apical endpoints in the acute toxicity assays, concentration-response relationships for the different fractions can be deduced. A critical evaluation of the suitability of the applied test protocols for the assessment of adverse effects of MP will be presented. (2.) Influence of ageing plastic and leachates on biofilm structure and function: Natural biofilms (containing bacteria, algae and fungi, embedded in extracellular polymeric substances) grown on microcosms on different types of aged and pristine polymeric substrates have been studied to observe the influence of weathering on the attachment and succession of biofilms. Sum parameters (biomass, pigment profiles, photosynthesis) and sequencing data were studied. (3.) Mixture effects of leachates from the most common polymers: Cell-based bioassays have been applied to study mixture effects of additives and degradation products of the polymers liberated during weathering of plastic material in artificial seawater in agitated UV chambers. The chemicals in the seawater leachates were enriched by solid-phase extraction or chemicals were directly extracted from pristine particles by ultrasonic-assisted solvent extraction. The concentrated leachates and solvent extracts were then dosed into cell-based bioassays, covering i) cytotoxicity; ii) accumulation of metabolic toxicants, e.g. via binding to cellular carbon receptor; iii) specific, receptor-mediated effects such as estrogenicity; and iv) adaptive stress responses such as oxidative stress. The results may help to understand effects caused by additives and parent compounds opposed to the degradation products liberated from the UV-weathered plastic.

Occurrence and characteristics of fine microplastics in sewage water, domestic water, sewage treatment water and river water by coagulation and FT-IR microscopy method

Y. Kameda, Chiba Institute of Technology / Creative Engineering; N. Yamada, T. Yasuda, Chiba Institute of Technology.

The occurrence of Microplastics (MPs) is of great concern in aquatic environment, especially ocean. Many current studies evaluate MPs ranged from 100 µm to 5 mm. However, MPs used in personal care products and other industrial processes are reported to be smaller according to previous reports. Because MPs are very...
important substances to current economic activities, new materials for MPs will be needed such as cellulose. Though alternative of the materials is mainly conducted in personal care products, effect of the volunteer actions and various regulations on decrease of MPs in aquatic environments has not been evaluated. It is necessary to reveal their sources such as sewage water, sewage treatment waste, wastes in aquatic environments and so on. This research shows occurrence and characteristics of MPs in sewage water, sewage treatment plants and sewage sludge, and MPs in river water by coagulation and FT-IR microscopy method developed in our laboratory. MPs in the various contaminated water were collected by a plankton net whose mesh size is 10 µm. The collected particles were separated by a density separation method. After that, MPs in the collected particles were separated by coagulation process. Finally, the MPs were passed through a membrane and were identified by standard methods. The results of MPs by FT-IR microscopy, MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrum data. Based on these data, contribution of MPs from personal care products to total MPs concentration will be discussed as well as estimation of sources of MPs in various water samples.

TU160
Detection of micro-paint particles and microplastic in harbour soil samples using FPA-µFTIR-Imaging-FTIR
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; M. Simon, N. van Alst, F. Liu, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering; R. Hurley, (presented by) R. Hurley, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences

Wastewater is considered to be one of the major sources of microplastics (MPs) entering surface waters. Although a high retention potential of wastewater treatment plants (WWTPs) for MPs in raw wastewater has been reported, the composition using FTIR spectroscopy. Finally, the most suitable characteristics of the studied samples are presented.

TU161
Runoff of microplastics from agricultural soil: a study in a semi-arid area
R. Harling, NIVA - Norwegian Institute for Water Research; T.C. Schell, IMDEA Water Institute / Ecotoxicology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; L. Nizzetto, NIVA

More than 90% of microplastics (MPs) present in raw wastewater are captured by wastewater treatment plants and removed in the sludge phase. Therefore, the use of sludge as a fertiliser for agricultural soils may be a relevant matter under semi-arid climate: hot and dry summer, low rainfall (about 450 mm per year) which is concentrated in spring and autumn. Suitable devices for runoff collection (modified Pinson collectors) were placed on three different plots with different MPs treatments: (i) soil never treated with sludge (control), (ii) soil treated with sludge in the past (in 2013), and (iii) soil treated with sludge at the start of the experiment (November 2017), according to usual agricultural practices. Besides sludge application, soil characteristics (composition, texture, etc.) were comparable in the three plots. Sludge was applied early November and the plots were sown with barley. After each relevant rainfall event, runoff water was collected and filtered in-situ and to isolate the MP fraction. Soil samples were taken in all plots at the start of the experiment, as well as 3, 6 and 12 months after the start of the experiment. To determine the vertical MP transfer within the soil, soil cores were divided into three fractions (0-5, 5-10, 10-15 cm). Separated plots receiving the same sludge treatments and soil conditions were used to sample earthworms and to study potential accumulation and MP impacts on the soil fauna. The content of MPs in runoff water, soil and biological samples were extracted using organic matter digestion (soil and organism samples), density separation (soil samples), and filtering (all samples). MPs were identified visually and characterised chemically using FTRI. Preliminary results of this experiment, which can be used to quantify fluxes and emissions of MPs in agro-ecosystems under semi-arid conditions, are presented.

TU162
Microplastics in wastewater and freshwaters: a case-study in the Henares river watershed (Central Spain)
T.C. Schell, IMDEA Water Institute / Ecotoxicology; R. Hurley, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences

Microplastics in wastewater and freshwaters: a case-study in the Henares river watershed (Central Spain)
T.C. Schell, IMDEA Water Institute / Ecotoxicology; R. Hurley, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences

Microplastics are characterized by materials, size, color and multi-regression analysis by FT-IR spectroscopy. Finally, the most suitable characteristics of the studied samples are presented.

TU163
Microplastics occurrence and composition in drinking water from a Norwegian urban area
a. gømieri, International Research Institute of Stavanger / Environment; G. Skjørberg, IVAR; K. Øysæd, A. Valand Kruvel, International Research Institute of Stavanger

Microplastics as a potential health and environmental problem has gained increasing attention recently. Microplastic is defined as plastic pieces smaller than 5 mm in diameter, and the sources of microplastic are many. State of the art literature reports that microplastics are ubiquitous worldwide. While several authors report fragmentary data on different points, the literature on MPs in drinking waters is lacking. The current study is part of a larger project to assess the environmental and human health implications of this problem. The results of this study are presented.
detect microplastic particles in drinking water supply systems with special focus on different polymeric composition and size fractions. Study area was the Rogaland area (Norway) populated by approx 110,000 inhabitants. Samples of drinking water were collected every two week for ten months contemporary from the supply water system collection point as well as in different sites of the urban area. A fast and sensitive method based on a GCMS-pyrolysis was developed. Polyethylene, Polypropylene and Polyvinyl chloride were the most recurrent polymers. Levels ranged from 0.02 to 16 ng/L. Time and space related trend are presented.

TU164 Macro and Micro(plastics) in the Environment of Some French rivers

V. Vernery, CNRS ICCF / Photochimie-CVP; G. Bissagou Koomba, UCA; A. Cattelain, F. Delor Jestin, Signe ICCF; Z. Donninan, H. Askanian, CNRS ICCF. J. Peiry, E. Roussel, O. Voldoire, CNRS-Geolab; A. Schaal, L. Durantou, Observatoire du Microplastique; M. Liboiron, Memorial University of Newfoundland

It is now known that the vast majority of microplastics found in the seas and oceans originate from lands. In such a process freshwater environment (rivers and riverbanks) play a major role. It is therefore necessary to imagine the scenario that a used plastic, becoming a waste after use, will be found in the environment if it has escaped to a waste treatment stream. Its stay in the environment can persist for a very long time and this waste will then be exposed to a set of environmental constraints (UV, rain, wind, mechanical erosion, ...), which will continue and amplify its degradation, leading to its fragmentation. The work we undertaken consists of: 1) Mapping the contamination density and extent of the area; 2) The fate and environmental bioavailability of microplastics present on the banks of an experimental site of the Allier River, and linking it to the density of the vegetal areas. 2. Set up on site a controlled pollution to follow its fate along the time. 3. Analyze the composition of microplastics extracted from the sediments, especially at the entrance of the abandoned channel, where it may exist some vortices of flow. These first three points are the topic of the Plasticcages project supported by the CNRS[1, 2]. 4. Collect and analyze the composition of microplastics in the surface waters of different rivers (Allier, Charente, Loire, Touvre, etc.). To do this, we rely on citizen science operations, in particular thanks to the contribution of the babylegs citizen science operations, in particular thanks to the contribution of the babylegs sampling net [3,4], which makes it possible to multiply samples and analyses. 1. Occurrence of plastic litters in the Allier river in France. Vincent Vernery, Gaëlle Bissagou Koomba, Alexandre Garreau, Florence Delor-Jestin, Erwan Roussel, Olivier Voldoire, Jean-Luc Peiry; To be published 2- https://www.researchgate.net/project/PLASTICCAGES 3- Commission agency, the case of babylegs, Max Liboiron, Engaging Science, Technology and Society 3(2017), 499-527 4- http://lapagialiasauvegarde.org/laboratoirerecyclon/}

TU165 Spatial and temporal trends of microplastics in an urbanized Canadian river

M.S. Ross, T. Bujaczek, S. Kolter, MacEwan University / Department of Physical Sciences; D. Locky, MacEwan University / Department of Biological Sciences

Microplastics are ubiquitous contaminants in the marine environment, but questions remain on their presence in urban landscapes and their environmental fate. This study investigates the occurrence, composition, and potential sources of microplastic contamination in the North Saskatchewan River, an urbanized river flowing through the city centre of Edmonton, Alberta, the fifth largest city in Canada. Surface water samples were collected monthly during the summer of 2017 using plankton nets with 53µm mesh. Samples were collected from seven sites throughout the city and potential point sources (i.e., a wastewater treatment plant, WWTP). Microplastics were found in all samples, and at some sites concentrations exceeded those reported in other urbanized rivers. Various colour fragments, films, beads, and fibers were identified, with the majority of microplastic contamination being in the form of plastic thread. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per 100m³ in March 2016 in Victoria Harbour (West Kowloon). Therefore, we also study the effluents directly discharged from chemical enhanced primary sewage treatment works (Stonecutters Island STW) and secondary sewage treatment works (Sha Tin STW, and two stormwater outfalls (SWOs) (Kwun Tong Ferry Pier, New Yau Ma Tei Typhoon Shelter) which are potential microplastic pollution sources entering into the Victoria Harbour. Effluent samples from each of these sources were collected in three weekdays per month and different seasons (December, March, June and September) to determine spatial, temporal (seasonal) variations of microbeads in treated sewage and stormwater discharges. The average concentrations of microbeads present in effluents from STWs and SWOs respectively ranged from 137,239 to 1,081,597 particles per 100m³ (December 2016 to March 2017) that consider as moderate emission level. Biological samples (fishes and mussels) are also collected in two SWO for the assessment of microbeads abundance and composition in its digestive system. Microplastics of different shapes from sewage and biota (mainly fragments, lines, fibres, and pellets) were identified by means of Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy. Zebrafish exposed to microbeads individually would ingest different sizes of polyethylene microbeads (10-22µm, 45 to 54µm, 90-106µm, 212-250µm & 500-600µm) and their digestive tracts and gill filaments were fully occupied by microbeads. Mixtures of microbeads in environmental related concentrations are used for expression profile of cytochrome P450 1A1(CYP1A1) and γ-glutamyltransferase (γGT). The highest expression experiments in zebrafish adult (Danio rerio) are 1) the upper and lower size boundaries for microbeads ingestion (ingestion range:10 to 600µm), 2) amount of microbeads accumulated inside the digestive tracts, and 3) expression profile of oxidative stress-related gene (CYP1A1) and endocrine-related gene (VTG1).

TU166 Models for Data Synthesis, Sampling Design and Scenario Analysis: Some using the INCA-MP model of microplastic fate and transport in soils and surface waters

M. Futter, Swedish University of Agricultural Sciences / Aquatic Sciences and Assessment; J. Crossman, University of Windsor; J. Ledesma, V. Russo, E. Lannerångård, SLU Swedish University of Agricultural Sciences / Aquatic Sciences and Assessment; L. Nizzetto, NIVA

Quantification and classification of microplastics in soils, sludge and surface waters is both time consuming and expensive. Ideally, measurement campaigns can be focussed on areas that are likely to provide the greatest returns on effort yet this is often difficult to reconcile. Here, we show how the INCA-MP, the Integrated Catchments model for Micro Plastics, is the first published model of microplastic terrestrial fate, riverine transport and contaminant co-transport can be used to synthesise available data, identify knowledge gaps, plan monitoring, and perform risk assessments. Synthesising available data involves collation of microplastic and proxy data. We show how proxy information, including timing and size distributions of proximally sourced material, can be used to improve the INCA-MP and high frequency water quality monitoring can constrain estimates of microplastic mobility in terrestrial and freshwater environments. Through the application of uncertainty analysis in INCA-MP, it is possible to identify the most sensitive pools and processes when making predictions of microplastic fate and transport. Furthermore, knowledge gaps related to these pools and processes can then be targeted for more intensive field sampling campaigns. As an INCA-MP includes sophisticated routines for tracking the environmental fate of current and emerging micropollutants, the model can be used for risk assessment of co-transported contaminants. Such information is needed both for more targeted sampling
campaigns and for communicating risks associated with microplastics in terrestrial and freshwater environments. We illustrate these concepts using data from Swedish and Canadian catchments. Our results show the importance of autumn storms and spring snowmelt for microplastic mobilisation to surface waters and highlight the potential knowledge gains associated with targeted sampling of riverine sediments, constructed wetlands and waste treatment facilities.

TU169 Occurrence and concentration of microplastics in an urban river
C. Campanella, C. Massarelli, G. Bagnuolo, Italian National Research Council; V. Urricio, Italian National Research Council / Water Research Institute

The term ‘microplastics’ was first used in 2004 to describe very small fragments of plastic (<50 µm) in the water column and in sediments. In 1986, 1.52 to 13.43 µm 3 showing significantly higher abundances during February than April campaign (Mann–Whitney U Test = 18.00; p-value = 0.028). A total of five polymer have been characterized: PE, PP, PS, PVC and TDI-PUR. All samples contained at least three polymer types: PE, PP and PS. PE accounted for 77% of the total particles identified, followed by PS (12%), PP (10%), PVC (9.0%) and PU (0.4%).

TU170 Removal of 10-500 µm microplastics from wastewater effluent by disc filter
M. Simon, Aalborg University; N. van Alst, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering; F. Liu, J. Voltersen, Aalborg University / Civil Engineering Department

In this study the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10-500 µm and the identification technology was micro-FTR imaging spectroscopy applying a focal plane array (FPA). Effluent wastewater was collected at the wastewater treatment facility at Grindsted, Denmark operated by Billund Spildevand A/S. The treated wastewater was sampled before and after the disc filter by using one 10 µm stainless steel screen from a large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical oxidation and filtration in order to eliminate the sample matrix and extract the microplastics. Non-degradable particles were stored in ethanol, and a fraction of the ethanol particle suspension transferred to a transmission window to quantify particles by infrared imaging technique. The entire window was scanned to create a mosaic with 3.3 µm pixel resolution on the FPA. The spectra of all particles in a scan were analyzed to quantify their chemical composition and to determine whether they were of plastic, and if so, of which plastic material. The optical analysis was carried out with a semi-automated IR spectra analyzer software developed at Aalborg University, Denmark. The size and shape of plastic particles were recorded and their mass was estimated. Preliminary data shows that the removal efficiency of the disc filter was 96% in terms of both mass and particle number. The material composition of plastic in the sample before the filter (polystyrene, polyethylene terephthalate, polypropylene) in the 30s, 40s and 50s, first traces of plastics in the environment have been detected. Packaging, pellets and parts of a kitchen sponge were found in the stomachs of seabirds; Whales and seals were caught in polypropylene cords. By weathering and fragmenting larger plastic objects (macroplastics) into smaller pieces (microplastics), plastic waste in the environment seems to be gradually disappearing. However, as recent research shows, microplastic is found in freshwater, on beaches and in open water, in the deep sea and in the Antarctic ice. It is taken up by organisms and passed on to the food chain. The long distance transport methods suggest that plastic waste will accompany, if not outlast, mankind for a long time to come. Although the number of publications on microplastics has risen in the last two decades and the topic has entered the social discourse, there are still many research gaps on sources, pathways, amounts, sinks, accumulation spaces, adsorption and absorption of pollutants as well as damaging effects on organisms and humans. The project PlasticBudget is aiming to close some of the above-mentioned research gaps. Taking into account the relevance that plastic litter has gained in recent years in the environmental discussion, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on ecotoxicity (for example, when birds or fish confuse plastic with food) and human toxicity (for example by eating food, which contains microplastics). The resulting environmental impacts could be, for example, the extensively documented dying of marine organisms by microplastics, the danger of massive aggregation of tiny plastic particles in the food chain, or even the negative aesthetic impact associated with plastic in the environment. Corresponding midpoint and endpoint indicators and associated characterization methods, as well as standardization to a reference value (e.g. the production volume of the specific plastic), are therefore developed in the PlastikBudget-project and discussed in expert dialogues as well as workshops.

TU172 How do we know that microplastics are different from natural particles in their effects on biota?
Z. Gerdes, M. Ogonowski, E. Gorkhokova, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES)

Microplastics (MP) have been identified as a potential environmental hazard, which has motivated a wide range of effect-studies, testing different combinations of polymers, sizes and shapes. However, risk assessment of MP exposure, in the lower size range < 100µm, is today hampered by both the lack of data regarding their presence in the environment and the inadequate experimental design of many effect-studies. A crucial issue in designing such studies is to include control particles that are ubiquitously present in the environment and represent a background variability with regard to suspended solids. Such controls, allow effects caused by individual MP particles to be distinguished from those caused by other suspended particles. This separation is crucial for testing MP-specific effects, as many test organisms are suspension-feeders that have evolved in turbid aquatic environments. To highlight and provide examples of the importance of particle controls in MP-effect studies we will present: I) results of a review on effects of particle suspensions (MP, or natural nutritionally inert particles), and II) case studies employing control particles. The data strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics
S. Seidensticker, J. Lamprecht, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience; C. Zarfl, University of Tuebingen / Center for Applied Geoscience

The ubiquitous contamination of all environmental compartments with microplastic particles is extensively discussed in both science and public. Large numbers of microplastics have been measured in effluents of wastewater treatment plants. These particles might act as sorbent and transporter for frequently occurring wastewater contaminants and are hence a factor that needs to be considered if the environmental fate of pollutants is examined. Some contaminants, among those also micropolllutants like pharmaceuticals, can be charged under certain pH conditions. While it is known for many microplastics to have a negative aesthetic impact associated with the negative aesthetic impact associated with plastic litter, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on ecotoxicity (for example, when birds or fish confuse plastic with food) and human toxicity (for example by eating food, which contains microplastics). The resulting environmental impacts could be, for example, the extensively documented dying of marine organisms by microplastics, the danger of massive aggregation of tiny plastic particles in the food chain, or even the negative aesthetic impact associated with plastic in the environment. Corresponding midpoint and endpoint indicators and associated characterization methods, as well as standardization to a reference value (e.g. the production volume of the specific plastic), are therefore developed in the PlastikBudget-project and discussed in expert dialogues as well as workshops.

TU171 PlasticBudget - Project on the environmental assessment of microplastic emissions
N. Thomemann, Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

Shortly after the introduction of many types of plastics (e.g. polystyrene, polyethylene terephthalate, polypropylene) in the 30s, 40s and 50s, first traces of plastics in the environment have been detected. Packaging, pellets and parts of a kitchen sponge were found in the stomachs of seabirds; Whales and seals were caught in polypropylene cords. By weathering and fragmenting larger plastic objects (macroplastics) into smaller pieces (microplastics), plastic waste in the environment seems to be gradually disappearing. However, as recent research shows, microplastic is found in freshwater, on beaches and in open water, in the deep sea and in the Antarctic ice. It is taken up by organisms and passed on to the food chain. The long distance transport methods suggest that plastic waste will accompany, if not outlast, mankind for a long time to come. Although the number of publications on microplastics has risen in the last two decades and the topic has entered the social discourse, there are still many research gaps on sources, pathways, amounts, sinks, accumulation spaces, adsorption and absorption of pollutants as well as damaging effects on organisms and humans. The project PlasticBudget is aiming to close some of the above-mentioned research gaps. Taking into account the relevance that plastic litter has gained in recent years in the environmental discussion, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on ecotoxicity (for example, when birds or fish confuse plastic with food) and human toxicity (for example by eating food, which contains microplastics). The resulting environmental impacts could be, for example, the extensively documented dying of marine organisms by microplastics, the danger of massive aggregation of tiny plastic particles in the food chain, or even the negative aesthetic impact associated with plastic in the environment. Corresponding midpoint and endpoint indicators and associated characterization methods, as well as standardization to a reference value (e.g. the production volume of the specific plastic), are therefore developed in the PlastikBudget-project and discussed in expert dialogues as well as workshops.

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics
S. Seidensticker, J. Lamprecht, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience; C. Zarfl, University of Tuebingen / Center for Applied Geoscience

The ubiquitous contamination of all environmental compartments with microplastic particles is extensively discussed in both science and public. Large numbers of microplastics have been measured in effluents of wastewater treatment plants. These particles might act as sorbent and transporter for frequently occurring wastewater contaminants and are hence a factor that needs to be considered if the environmental fate of pollutants is examined. Some contaminants, among those also micropolllutants like pharmaceuticals, can be charged under certain pH conditions. While it is known for many microplastics to have a
species did not contribute. Thus, with increasing pH sorption of acids decreased while the sorption of bases increased. Whereas electrostatic interactions between charged species and polyethylene could not be detected, this might be different for other polymers, such as polyethylene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil T. Hiffer, S. Slawek, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The worldwide production and usage of mainly disposable plastic has increased from 1.7 million tons in 1950 to 299 million tons in 2013 [1]. Consequently, plastic wastes are deposited in the environment and persist due to long durability and limited recovery [2]. Polyethylene is one of the mass-manufactured polymers that is found in the terrestrial environment, used in many different sections, including agricultural mulches, composites and packaging material [3]. To date, microplastics have been mainly studied in marine and freshwater systems, while there is hardly any data on microplastic occurrence, fate, and effect in terrestrial environments [2].

Low-density polyethylene (LDPE) foils, that may become brittle due to isolation, are used in large amounts on agricultural areas to protect crops, suppress weeds, regulate the temperature and retain irrigation water in the soils [1]. In soil microplastics may affect the transport of hydrophobic organic pollutants and pesticides, as they can be preferentially sorbed by polymer particles with large surface to volume ratio compared to sorption by natural sorbents [1, 4]. The strength of sorption as well as the relevant molecular interactions depend on the polymeric hydrophobicity, because they can interact [5]. These characteristics of this study, like pesticides or pharmaceuticals, transport them into food chains and modulate their toxicities. In addition, they can mechanically affect exposed organisms. Whereas in the past, most of the studies on microplastics have focused on the marine environment, and understand how aging affects the microplastics found in marine environment, and understand how aging affects the microplastics experienced mechanical erosion and weathering. These results showed that an accelerated artificial weathering process produces in polypropylene microplastics using ATR-FTIR. This could be useful to identify real plastics and microplastics found in marine environment, and understand how aging affects the surface and chemical structure of this material. New sorption peaks can be seen, that reveals changes in the main structure of the microplastics. Some indexes were calculated as the ratio of these IR bands to a reference peak that indicate oxidized carbon in the plastic hydrocarbon chain. It is worth to note that the direct identification of the type of polymer is usually not possible. Weathering-related changes in the IR spectra difficult the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done to investigate the influence of microplastics on the transport of organic contaminants in a soil under varying aqueous conditions. [1] K. Duis, A. Coors, Environ. Sci. Eur. 2016, 28, 2. [2] M. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornm, M. Bajirami, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson. Mar. Pollut. Bull. 2012), 64, 7828. [5] T. Hiffer, T. Hofmann, Environ. Pollut. 2016, 214, 194.

TU175 Influence of polystyrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornuarietis: behavioral and biochemical responses S. Kraus, University of Tubingen / Animal Physiological Ecology; H. Schmieg, Tübingen University / Animal Physiological Ecology; E.E. May, University of Tuebingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; R. Triebkorn, University of Tuebingen / Animal Physiological Ecology

Microplastics are of particular interest in ecotoxicology, because they can interfere with organic substances like pesticides or pharmaceuticals, transport them into food chains and regulate the temperature and retain irrigation water in the soils. Very small-sized particles and fibers (< 5 mm) which are defined as microplastics result either from degradation of macroplastics or are produced as primary microplastics which are contained e.g. in cosmetics. Microplastics are known to leach toxic chemicals like pesticides or pharmaceuticals, transport them into food chains and modulate their toxicities. In addition, they can mechanically affect exposed organisms. Whereas in the past, most of the studies on microplastics have focused on the marine environment, there is still little knowledge about the occurrence and impacts of microplastics in freshwater ecosystems. The aim of this study is to examine possible influences of polystyrene particles in combination with different organic pesticides on the behavior and biochemical responses of the giant rams-horn snail (Marisa cornuarietis). Snails were exposed to 10.000 polystyrene particles per liter (cryogenically milled, < 100 µm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiacloprid. In order to investigate the influence of microplastics on the transport of organic contaminants in a soil under varying aqueous conditions, [1] K. Duis, A. Coors, Environ. Sci. Eur. 2016, 28, 2. [2] M. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornm, M. Bajirami, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson. Mar. Pollut. Bull. 2012), 64, 7828. [5] T. Hiffer, T. Hofmann, Environ. Pollut. 2016, 214, 194.

TU176 Effects of artificial weathering on polystyrene microplastics V. Fernández-González, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); G. Grueiro-Noche, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); J.M. Andrade-Garda, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); P. López-Mahía, Universidad de Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Muniategui, Universidade da Coruña / Analytical Chemistry

Microplastics are defined as plastic materials or fragments with diameter below 5 mm. These microplastics occur due to the release of manufactured (primary) microplastics in various products and the breakdown of larger plastic litter (secondary microplastics). The time required for plastic to degrade under natural conditions is estimated to be millions of years. They are exposed to photo-oxidation by UV light its primary degradation pathway. The small fragments of microplastic created by weathering are detrimental to ocean ecosystems for multiple reasons. In the frame of the BASEMEN project (JPI Oceans) 9 natural microplastics of different polymers materials, in two size presentations (100-500 µm and pellets ≤1 mm) were artificially weathered. A pilot-scale simulated weathering system (dry conditions and simulated marine conditions), using UV/Vis metal halide lamps, was deployed. This study focuses on the characterization of the changes that an accelerated artificial weathering process produces in polystyrene microplastics using ATR-FTIR. This could be useful to identify real plastics and microplastics found in marine environment, and understand how aging affects the surface and chemical structure of this material. New sorption peaks can be seen, that reveals changes in the main structure of the microplastics. Some indexes were calculated as the ratio of these IR bands to a reference peak that indicate oxidized carbon in the plastic hydrocarbon chain. It is worth to note that the direct identification of the type of polymer is usually not possible. Weathering-related changes in the IR spectra difficult the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done to investigate the influence of microplastics on the transport of organic contaminants in a soil under varying aqueous conditions. [1] K. Duis, A. Coors, Environ. Sci. Eur. 2016, 28, 2. [2] M. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornm, M. Bajirami, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson. Mar. Pollut. Bull. 2012), 64, 7828. [5] T. Hiffer, T. Hofmann, Environ. Pollut. 2016, 214, 194.
Analytical Chemistry (ACES)

Conventional, oil-based polymers are considered as the major source of microplastic pollution, whereas biodegradable polymers (bioplastics) have not attracted much attention as sources of microplastics. However, given that production of bioplastics is increasing and that biodegradation is slow under ambient conditions, it is likely that they enter the aquatic environment in the same way as the other plastics. The PMP had a similar history to SMP, and it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polylactic acid (PLA; biopolymer) and polystyrene (PS; oil-based polymer) on primary life history traits in the crustacean Daphnia magna, a standard model species in ecotoxicology. To exclude particle effects caused by food dilution and thus identify microplastic-specific effects, kaolin clay was used as a reference treatment. In total, four treatments were included: PLA, PS, clay (reference), and control (food only). The exposure was conducted over 21 d using a plankton wheel to keep test particles and algae in suspension for comparable exposure concentrations. In the PS treatment, we observed high mortality, decreased feeding rate and reproductive output compared to all other treatments. These effects were not caused by toxic monomers of styrene or additives leaching out of the polymer, which was demonstrated in a follow-up test with the PS leachates. By contrast, no significant effects were found in the daphnids exposed to PLA compared to the reference treatment. Thus, a significantly higher toxicity of the conventional polymer was observed, whereas effects of the biodegradable microplastics were similar to those caused by the ubiquitously occurring clay particles. More studies are needed to identify the mechanisms of PS toxicity and to confirm the observed ecotoxicologically relevant effects of PS particles by means of the polymer type used during different exposure conditions. To evaluate toxicity of these materials, it is essential to include a reference treatment as a benchmark.

TU179

Effects of polystyrene microplastics in different life stages of brown trout (Salmo trutta f. fario)

H. Schmieg, Tübingen University / Animal Physiological Ecology; S. Krais, University of Tubingen / Animal Physiological Ecology; F. Rezbach, University of Tubingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; R. Truesbork, University of Tubingen / Animal Physiological Ecology The widespread use of plastic products in our daily life has led to a constant increase in the production of synthetic polymers. In consequence and also resulting from the longevity of plastics, high amounts of plastic debris can be found worldwide in aquatic and terrestrial environments. In general, plastic items smaller than 5 millimeters are defined as microplastics. Primary microplastics are produced for certain purposes and are, for example, contained in many cosmetic products. Abrasion and fragmentation of larger plastic items lead to the formation of secondary microplastics. Up to now, most studies investigating effects of microplastics on organisms concentrate on marine ecosytems, whereas knowledge on effects of microplastics in freshwater organisms is still scarce. The aim of our study is to investigate effects of polystyrene microplastics (cylindrically milled granules, fractionated to < 28 µm, up to 100,000 particles/L) in combination with organic pollutants (pharmaceutical, pesticide), in different life stages of brown trout (Salmo trutta f. fario). For that purpose, we conducted a fish early life stage test (FELST) according to OECD 212. The endpoints of interest were heart rate, hatching success and mortality. After consumption of the yolk sac by the fish larvae, we additionally investigated the level of oxidative stress by means of the fluorescent probe 2′,7′-dichlorodihydrofluorescein diacetate (H2DCFDA). In addition, we examined effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methiocarb in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larval or juvenile brown trout. Further analyses are still in progress. The present study is part of the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WRS1578).

TU180

Daphnids in distress? Acute and chronic effects of primary and secondary microplastics on three species of Cladocerans

G. Jakumar, CML Leiden University / CML; N. Brün, CML Leiden University / Conservation Biology; J. Baas, Centre for Ecology & Hydrology / Centre for Ecology and Hydrology (CEH); R. Casas, CML Leiden University / Centre for Environmental Microbiology; T. Bosker, CML Leiden University / Ceter for Environmental Sciences Microplastics (< 5 mm) are ubiquitously distributed in the environment, causing increasing concern in recent years. The two predominant types of microplastic differ in shape and origin: primary microplastics (PMP) are intentionally produced as micro-particles for commercial applications, whereas secondary microplastics (SMP) are formed by the environmental breakdown of large plastics. Information regarding effects of microplastics on freshwater ecosystems is limited. In the present study, the acute and chronic effects of microplastics on three Cladoceran species, Daphnia magna, Daphnia pulex, and Ceriodaphnia dubia, to both PMP and SMP was assessed. The acute toxicity was assessed at 180, 220, and 260 C, to determine the influence of temperature as an additional stressor on toxicity. The acute sensitivity of D. magna and D. pulex to both PMP and SMP, increased sharply with temperature, whereas that of C. dubia was stable across temperatures. C. dubia was the most sensitive species at 180, followed by D. pulex and D. magna, which were of comparable sensitivity, however, the trend was reversed at 260 C. In addition, both PMP and SMP had a similar effect on C. dubia, whereas the toxicity was more toxic to C. dubia. Both PMP and SMP showed adverse effects on all three species during chronic exposure. Further, C. dubia was the most sensitive species followed by D. pulex and D. magna. All species were more affected by PMP than SMP during chronic exposure. The results of the current study indicate that exposure to microplastics has adverse effects on health and reproductive output of the species studied, although at relatively high levels of exposure, and that temperature as an environmentally relevant additional stressor has a major influence on species sensitivity to microplastics.

TU181

Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels

S. Magni, University of Milan / Department of Biosciences; F. Gagne, Environment and Climate Change Canada; C. DELLA TORRE, State University of Milano / Biosciences; C. André, J. Auclair, H. Hanana, Environment and Climate Change Canada / Aquatic Contaminants Research Division; F. Bonasoro, University of Milan / Department of Environmental Science and Policy; A. Binelli, University of Milano / Department of Environmental Science and Policy; A. S. Ruhl, TU Berlin / Department of Water Quality Control; E. Paolo Ruperti, University of Milano / Department of Environmental Science and Policy; S. Magni, University of Milano / Department of Environmental Science and Policy; A. Binelli, University of Milano / Department of Environmental Science and Policy; A. S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; S. Krais, University of Tubingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; S. Krais, University of Tubingen / Animal Physiological Ecology The widespread use of plastic products in our daily life has led to a constant increase in the production of synthetic polymers. In consequence and also resulting from the longevity of plastics, high amounts of plastic debris can be found worldwide in aquatic and terrestrial environments. In general, plastic items smaller than 5 millimeters are defined as microplastics. Primary microplastics are produced for certain purposes and are, for example, contained in many cosmetic products. Abrasion and fragmentation of larger plastic items lead to the formation of secondary microplastics. Up to now, most studies investigating effects of microplastics in organisms concentrate on marine ecosystems, whereas knowledge on effects of microplastics in freshwater organisms is still scarce. The aim of our study is to investigate effects of polystyrene microplastics (cylindrically milled granules, fractionated to < 50 µm, up to 100,000 particles/L) in combination with organic pollutants (pharmaceutical, pesticide), in different life stages of brown trout (Salmo trutta f. fario). For that purpose, we conducted a fish early life stage test (FELST) according to OECD 212. The endpoints of interest were heart rate, hatching success and mortality. After consumption of the yolk sac by the fish larvae, we additionally investigated the level of oxidative stress by means of the fluorescent probe 2′,7′-dichlorodihydrofluorescein diacetate (H2DCFDA). In addition, we examined effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methiocarb in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larval or juvenile brown trout. Further analyses are still in progress. The present study is part of the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WRS1578).

TU182

Poly styrene microplastic effects on the lipid peroxidation and antioxidant capacity in non- and temperature-stressed individuals of Dreissena polymorpha

A. Weber, N. Jeckel, C. Weil, S. Umbach, Goethe University Frankfurt am Main / Aquatic Ecotoxicology; N. Breunholt, German Federal Institute of Hydrology / Biochemistry and Ecotoxicology; G. Reiffscheid, German Federal Institute of Hydrology; M. Wagner, Norwegian University of Science and Technology / Department of Biology Microplastic (MP) toxicity has been considered in numerous taxa including bivalves, which are of special interest due to their high filtration activity and therefore MP particle uptake. Previous studies in marine bivalves reported stress and inflammation processes in response to high levels of MP exposure, while data on freshwater species is missing. Therefore, we analyzed the effects of irregular polystyrene MP (< 63 µm) on the lipid peroxidation and antioxidant capacity in the freshwater bivalve Dreissena polymorpha both in a single and multiple stressor exposure regime. We exposed D. polymorpha to polystyrene MP at concentrations between 6.4 and 100,000 p M L−1 over 6 weeks at 16 °C. After the exposure, the midget gland tissues were analyzed for malondialdehyde concentrations as an indicator for lipid peroxidation (TBARS assay, thiobarbituric acid reactive substances) as well as for the remaining abundance of hydrophilic, non-enzymatic antioxidant substances (ORAC assay, oxygen radical absorbance capacity) – an estimate of the remaining antioxidant capacity. The analysis of lipid peroxidation
and antioxidant capacity did not indicate any increased stress levels in response to chronic MP exposure in *D. polymorpha*. In addition, the same experiment performed in a sub-chronic exposure (1, 3 and 7 d) did not reveal stress-induced effects either. Therefore, this study indicates that poly styrene MP does not induce a stress response in *D. polymorpha* in the current exposure scenario. In a more environmentally realistic scenario, bivalves will experience other stressors (e.g. increased water temperature) besides particulate matter. Thus, we hypothesize that a stress-like response can be modulated by MP exposure. To explore such a scenario further, we will present results from ongoing multiple-stressor experiments in which we expose *D. polymorpha* to MP at 16, 24 and 28 °C.

**TU183**

**Tissue Translocation of Polystyrene Micro- and Nanoparticles in Daphnia magna?**

C. Schueg, Goethe University Frankfurt / Dpt. Aquatic Ecotoxicology; S. Rist, DTU (Technical University of Denmark) / Department of Environmental Engineering; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; M. Wagenius, Norwegian University of Science and Technology / Department of Biology

The last decade has seen a surge in research investigating various aspects of micro- and nanoplastics originating from plastic pollution in aquatic ecosystems. Aspects include occurrence, uptake, and potential effects in biota. Working with particles in a laboratory setting bears its own kind of challenges, some of which had already been faced by researchers in the realm of nanotoxicology. Out of all ecotoxicology of biota-particle-interactions is still limited and often based on early studies that – due to the infancy of the field – may have deficiencies in the experimental design and quality controls. One such example relates to the potential of plastic particles to cross the gut epithelium and translocate to other tissues. This phenomenon has been reported in the literature for the freshwater cladoceran *Daphnia magna* and – if true – could explain some of the adverse effects seen while testing MP. To substantiate the limited available data, the aim of our study was to replicate these findings. We exposed neonate daphnids in a number of scenarios regarding particle concentration and exposure duration at two independent geographical locations using animals from two separate cultures. We expanded on the previous experiment by improving imaging through the addition of a fructose-based clearing followed by investigation through confocal laser scanning microscopy. We additionally applied the lipophilic dye nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoplastics. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microparticles under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body of knowledge. Our study also demonstrates that attempts of replication are microplastics studies is important, especially if these have a high impact on the body of knowledge. Our study also demonstrates that attempts of replication are needed to clarify.

**TU184**

**Do terrestrial organisms, isopods Porcellio scaber and earthworms Eisenia andrei, avoid microplastic contaminated soil?**

A. Jemec, University of Ljubljana, Biotechnical Fac. / Department of Biology; P. Zidar, University of Ljubljana / Department of Biology Biotechnical Faculty; G. Kalcikova, University of Ljubljana / Faculty of Chemistry and Chemical Technology

Microplastics (MP) can potentially enter the terrestrial environment via sewage sludge deposition on agricultural land. In some countries plastic bags are used as soil cover in home gardens and agricultural land to act as mulch film. Due to fragmentation of these plastic bags, secondary MP may enter the soil and can be further transported along the soil column by bioturbation. Despite the potential presence of MP in the terrestrial environment, data regarding the impact of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods *Porcellio scaber* and earthworms *Eisenia andrei* avoid soil contaminated with microplastic. We tested microplastic extracted from facial scrub and fragmented from plastic bag. The mean size of MP from facial cleanser was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 5.05 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/g dry weight (0.4 % w/w). The isopods were exposed individually and in groups of 10 animals. The test container comprised two identical polypropylene vessels connected with a fixed polypropylene tunnel to enable animal migration between the two vessels and covered with a lid. In individual exposure the position of each animal was recorded 10 times within the 48 h exposure period and the number of positions on each side was calculated. In group exposure, the isopods were inspected only after 48 h and the number of animals at each side was recorded. Earthworms were exposed in one test container that was divided when applying the control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behaviour towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil and were not affected by plastic bag MP. It remains to be investigated how longer exposure to MP would affect the behaviour of terrestrial organisms. Also it is of interest how environmentally aged MP (e.g. coated with biofilm) would affect the organisms. Knowledge in this field is important to assess the potential hazard of microplastic deposited on soil.

**TU185**

**Analysis of the Trojan horse effect of a mixture of microplastics and chlorpyrifos in an aquatic microcosm study**

I. Deerman, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; X. Chen, University College London; T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Besides their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported together into biota by the so called ‘Trojan horse effect’. In this study, a higher CPF could not be found in the water phase by applying flow cytometry/viSNE, which was performed with the aim to discover the Trojan horse effect by means of a laboratory aquatic microcosm study. The insecticide chlorpyrifos (CPF) was used sorbed to 5 μm polystyrene microbeads. Beside the control microcosms (C), an MP-control (MPC) group was treated with 4 mg MP/L. For two other treatment groups, the same concentration of MP was coated with nominal CPF concentrations of 0.5 μg/L (L) and 1 μg/L (H) in the water phase before application. With six replicates per treatment, all 24 aquariums were treated with 4 mg MP/L and a 3 cm sediment layer, both taken from outdoor ponds. The natural plankton community got enriched by the amphipod *Crangonyx pseu do gracilis*. After a pre-treatment period of five weeks, the experiment run for eight weeks. A chemical analysis of CPF in the water phase of the stock solutions and the treatment groups L and H (day 14) was performed. Since CPF could not be detected in neither of them, a strong sorption of CPF to MP is indicated. Abundances of *Daphnia pulex* revealed higher population increments in MPC than in C, L and H, indicating higher reproduction rates in the first two weeks after application. Furthermore, body lengths of juvenile D. pulex remained nearly constant during the test period in all MP treatments (MPC, L, H) while they increased in these cases in the controls (C). Interpreting these results, MP might have led to higher reproduction rates as a stress response which were lowered when CPF was present. In this case, CPF must have become bioavailable to *D. pulex* after ingestion of MP. For *C. pseudogr acilis*, total abundances increased the most in MPC, whereas L and H developed similar as C. As for the cladoceran, MP might have led to higher reproduction rates that were lowered by CPF. The Trojan horse effect has probably been found in *D. pulex* and *C. pseudogr acilis* in this study, as increased body lengths of juvenile *D. pulex* and increased weight (0.4 % w/w). The isopods avoided soil contaminated with microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body of knowledge. Our study also demonstrates that attempts of replication are needed to clarify.

**TU186**

**Microplastics exposures of fish: internalization and effects on behavior and growth**

C. vignet, Eawag / UTOX, X. Cousin, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; R. Behra, Eawag / Department of Environmental Toxicology; L. Joussard, IFREMER; L. Sigier, Eawag; M. Bégout, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; J. Cachot, University of Bordeaux / EPOC; K. Schirmer, Eawag / Environmental Toxicology

Awareness of the presence of microplastics, i.e. plastic particles ranging in size from 1 μm to 5 mm, in marine and freshwaters has recently risen but detection and quantification is challenging. Furthermore, whether they pose a risk to aquatic organisms is not yet clear. Interpreting these results, MP might have led to higher reproduction rates as a stress response which assessment has not yet been made. In this context, we are exploring methods for quantification upon feeding juvenile fish with regular food and microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body of knowledge. Our study also demonstrates that attempts of replication are needed to clarify.
feeding with microparticles contaminated food has consequences on juvenile fish growth. Taken together, our study demonstrates the power and limits of flow cytometry/viSNE for microplastics quantification in a complex biological matrix like fish. The setup could be extended to other types and forms of microplastics in different environmental matrices. Moreover, our study sheds light on ecological consequences that microplastics exposure might have on fish.

TU187
Microplastic ingestion by fish: a comparison of Thames Estuary and Firth of Clyde populations
A.R. McGoran, Royal Holloway; P.R. Cowie, Field Studies Council Scotland; P.F. Clark, The Natural History Museum; J.P. McEvoy, D. Morritt, Royal Holloway This study compares the ingestion of microplastic by pelagic and benthic fish populations from two major UK watersheds: the Thames Estuary and the Firth of Clyde. A total of 760 fish from 20 species and 116 brown shrimp, Crangon crangon, were sampled. Individuals were examined under a dissection microscope and potential plastics were removed to be later identified by FTIR analysis. Out of 21 species, including both fish and shrimp, sixteen species from different trophic levels ingested plastics. Overall, between 33–47% of fish ingested plastics, mostly fibres (85% of potential plastics; before FTIR analysis). In addition, microplastics were also found in the stomach of a common prey species, C. crangon, but had ingested far less plastic than predatory fish species, such as the European flounder, Platichthys flesus. In the Firth of Clyde, benthic, flatfish ingested significantly more plastic than pelagic fish and other benthic fish. This may indicate that, in estuarine systems, plastics accumulate in the sediment.

TU188
Poly styrene microplastic uptake and effects on feeding behaviour and reproduction in the cladoceran Daphnia magna
B. De Felice, Università degli Studi di Milano; R. Bacchetta, University of Milan; P. Tremolada, University of Milano / Department of Biomolecular Sciences and Biotechnology; M. Parolini, University of Milan / Department of Environmental Science and Policy Plastic contamination is a well-known environmental problem as demonstrated by the huge presence of plastic debris ranging different sizes in diverse aquatic ecosystems worldwide. In recent years, the attention has been attracted to microplastics (MPs), small plastic particles (dimensional range Daphnia magna) affecting food intake, growth and reproduction. First, we performed a 24 hours uptake and 48 hours release test to assess the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, release of MPs was exponential and after 72 hours of incubation they were still found massively in the digestive tract of treated individuals. The lack of a complete release of MPs can cause the blockage of the digestive tract and starvation, leading the crustacean to the death. Moreover, these effects can negatively affect body growth, swimming activity and, consequently, have strong consequences on reproduction, as suggest by a standard 21-day reproduction test.

TU189
Uptake of differently sized microplastics in gut passage by different species of Daphnia
S. SUIPLAN, University of Birmingham; I. Lynch, University of Birmingham / Geography Earth Environmental Science; J. Sadder, The University of Birmingham / Environmental Change Institute Plastic-debris, for example from textile weathering and washing, are increasingly accumulating in aquatic environments, and while they are now recognized as environmental pollutants, their impact on aquatic ecosystems is not yet fully understood (Jenec, 2016). Microplastics, which are synthetic polymers with a diameter smaller than 5 mm and extending down to the nanoscale, have a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.0–2.5 mm) to 20 g dwarf (1.3–2.0 mm) which spans a similar range of sizes as micro and nanoplastics, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polybead carboxylate microspheres (0.1, 1.0 and 10.0 µm) on freshwater cladocera of different body sizes (D. magna, D. pulex and D. galeata) after 24, 48, and 72 hours exposure to a range of mass concentrations (also compared on the basis of the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, release of MPs was exponential and after 72 hours of incubation they were still found massively in the digestive tract of treated individuals. The lack of a complete release of MPs can cause the blockage of the digestive tract and starvation, leading the crustacean to the death. Moreover, these effects can negatively affect body growth, swimming activity and, consequently, have strong consequences on reproduction, as suggest by a standard 21-day reproduction test.

TU190
Determination of microplastics in mackerel stomachs by enzymatic digestion and µFTIR
G. Grueiro-Noche, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); V. Fernández-González, J.M. Andrade-Guarda, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. Lórez-Mahlia, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Muniategui, Universidade da Coruña / Analytical Chemistry Plastic is one of the most used materials in the world and is one of the most common and persistent pollutants in the oceans. In fact, plastics constituent 60-80% of microplastics debris. A particular fraction of plastic debris are microplastics (5 Funds -75 mm). The presence and accumulation in the ocean is cause for concern for several reasons, one of the most important is that they can be ingested by marine biota [1]. Different studies have shown the effects on the biota, such as intestinal blockage, decreased mobility or death [2]. Microplastics can absorb persistent bioaccumulative and toxic compounds from seawater. Once ingested, the absorbed pollutants may be transferred to the respective organisms. A variety of methods has been developed to measure microplastics in biota. One important aspect of these analytical methods is the extraction of microplastics from interfering biomass. Many studies have employed one or more chemicals (KOH, H2O2) to dissolve the biomass, which can be destructive to the plastic particles and their surfaces and create interferences that were problematic for µ-spectroscopy-based analyses. Enzymatic digestion methods have been used to minimize damage to plastics [3]. An enzymatic digestion has been developed and optimized for digesting biological material without destroying microplastics. Different times and enzymes were tested to optimize the enzymatic protocol. In addition, the enzymatic protocol was compared with chemical digestion (KOH) for the treatment of mackerel stomachs. The optimized enzymatic protocol has been applied to the mackerel stomachs to quantify the microplastics debris present in the mackerel stomach. Identification and characterization of microplastics was done by µFTIR. Acknowledgement: Financial support is acknowledged to the Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) potentially co-financed by ERDF (ED431C-2017/28) and by the Ministry of Economy and Competitiveness (subproject PCT-2015-170-C02-01 with microplastics). Funds/BEARMAN (JPI Oceans) and, project CTM2016-77945-C3-3-R (ARPA-ACUA). References: [1] V. Hidalgo-Ruz, L. Gutov, R.C. Thompson and M. Thiel, Environmental Science & Technology 46, 3060 (2012); [2] M. Cole, H. Webb, P. K. Lindeque, E.S. Fileman, C. Halbsand and T. S. Galloway, Scientific Reports 4, 4528 (2014) [3] J. Wagner, Z.-M. Wang, S. Ghosal, C. Rochman, M. Gassel and S. Wall, Anal. Methods, 9, 1479 (2017)

TU191
Microplastic contamination of the model system Weser-National Park Wadden Sea: an across-ecosystem approach
S. Moses, University of Bayreuth / Animal Ecology I; M. Loeder, L. Scharn, C. Lachmund, University of Bayreuth / Analytical Chemistry Plastic-debris, for example from textile weathering and washing, are increasingly accumulating in aquatic environments, and while they are now recognized as environmental pollutants, their impact on aquatic ecosystems is not yet fully understood (Jenec, 2016). Microplastics, which are synthetic polymers with a diameter smaller than 5 mm and extending down to the nanoscale, have a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.0–2.5 mm) to 20 g dwarf (1.3–2.0 mm) which spans a similar range of sizes as micro and nanoplastics, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polybead carboxylate microspheres (0.1, 1.0 and 10.0 µm) on freshwater cladocera of different body sizes (D. magna, D. pulex and D. galeata) after 24, 48, and 72 hours exposure to a range of mass concentrations (also compared on the basis of the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, release of MPs was exponential and after 72 hours of incubation they were still found massively in the digestive tract of treated individuals. The lack of a complete release of MPs can cause the blockage of the digestive tract and starvation, leading the crustacean to the death. Moreover, these effects can negatively affect body growth, swimming activity and, consequently, have strong consequences on reproduction, as suggest by a standard 21-day reproduction test.

TU192
Photochemical fragmentation of freshwater (microplastics under UV irradiations
V. Verney, CNRS - ICCF / Photochimie-CVP; G. BISSAGOU KOUMBA, UCA-ICCF; F. Delor Jestin, Sigma-ICCF
We begin to understand and describe more and more the fate of a plastic waste arriving (and remaining) in the aquatic environment. Nevertheless, we still do not know many things, for example, the time scaling of the process from the abandonment of a waste, its arrival, and its persistence in the aquatic environment. During this period, the material will be exposed to various environmental aggressions that will initiate and spread the photocatalysis of the material. This scenario is accompanied by a physical fragmentation into smaller sizes, and a chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various plastic fragments (Polystyrene, Polypropylene and Polyactic Acid) immersed in fresh water and UV irradiated. We worked either with real wastes (from post-consumer sector) or with model polymers totally free of additives. The polymers were chosen for their different physical properties. Polystyrene behaves like a glass (Tg = 104 °C) at the temperatures of use, which is not the case of the PP (Tg = 0 °C). Finally, PLA can start hydrolysis reactions. During the exposure time, solids and liquids (a small volume of water) are taken for analysis ( bulk chemistry, ion and liquid chromatography). The main result is that in all cases there is a formation and leaching of short chain (1C, 2C, 3C) carboxylic acids (acetic and formic acids, lactic and glycolic in the case of PLA) all known to be markers of polymer degradation. In the absence of light no transfer of any acid in the liquid is recorded.

TU193 Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients

I. Davies, Personal Care Products Council / Science

Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (CPCPs) contain a wide array of polymeric ingredients which are identified by the International Nomenclature of Cosmetic Ingredients (INCI). An INCI name often represents several polymers with different physical and chemical properties. This often leads to one INCI named polymer existing as several physical forms. For example, polyethylene can exist as a solid plastic microbead or a non-plastic wax thickening agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and thus contribute to the litter load. Therefore, it is important to identify the polymers that are in exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPAA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

TU194 Toxicological effects of irregularly-shaped and spherical microplastics in a marine teleost, the sheepshead minnow (Cyprinodon variegatus)

J. Park, Korea Institute of Toxicology; J. Choi, Korea Institute of Korea KIT; Y. Jung, Korea Institute of Toxicology; S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group

Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards of microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus are typically irregular in shape. The objective of this study was to compare the effects of spherical or irregular shapes of microplastics on the changes in organ function, swimming, gene expression, and enzyme activities in sheepshead minnow (Cyprinodon variegatus). Both types of microplastics were accumulated in the digestive system, causing intestinal distention. However, irregular microplastics decreased swimming behaviors (total distance travelled and maximum velocity) of sheepshead minnow, when compared to spherical microplastics. Both microplastics generated cellular reactive oxygen species, while molecular changes (transcriptional and enzymatic characteristics) of key genes and enzymes, respectively were differed. This study provides insights into environmentally relevant (fragmented) microplastics will help to improve understanding of their environmental impacts.

Keywords: Microplastics, Sheepshead minnow, Behaviors, Gene expression/noun

TU195 Assessment of the microplastic contamination in sediments from the French Atlantic coast

N. Phuong, Universite de Nantes; L. Poiret, Universite de Nantes / MMS.

We begin to understand and describe more and more the fate of a plastic waste arriving (and remaining) in the aquatic environment. Nevertheless, we still do not know many things, for example, the time scaling of the process from the abandonment of a waste, its arrival, and its persistence in the aquatic environment. During this period, the material will be exposed to various environmental aggressions that will initiate and spread the photocatalysis of the material. This scenario is accompanied by a physical fragmentation into smaller sizes, and a chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various plastic fragments (Polystyrene, Polypropylene and Polyactic Acid) immersed in fresh water and UV irradiated. We worked either with real wastes (from post-consumer sector) or with model polymers totally free of additives. The polymers were chosen for their different physical properties. Polystyrene behaves like a glass (Tg = 104 °C) at the temperatures of use, which is not the case of the PP (Tg = 0 °C). Finally, PLA can start hydrolysis reactions. During the exposure time, solids and liquids (a small volume of water) are taken for analysis ( bulk chemistry, ion and liquid chromatography). The main result is that in all cases there is a formation and leaching of short chain (1C, 2C, 3C) carboxylic acids (acetic and formic acids, lactic and glycolic in the case of PLA) all known to be markers of polymer degradation. In the absence of light no transfer of any acid in the liquid is recorded.
The lowest eligible AF of 5. The SSD reveals branchiopoda and amphipoda being the most sensitive taxonomic groups for CPY. A re-evaluation of old and new mesocosm data showed that using the available mesocosm data for EQS derivation is likely to be underprotective for amphipoda. The original EQS dossier from 2005 contains no specific EQS derivation for sediment. It was concluded that “Protection of sediment [is] covered by the QS referring to the pelagic community”. The data sets are presented for chronic and bioavailable in data for sedimentary sites with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data suggest that the amphipods H. aztece might be as sensitive to CPY as the insects C. riparius and C. tentans but chronic data are available only for insects. The resulting sediment EQS_{bioav} of 0.32 mg/kg dw was derived by applying an AF of 100 on the chronic NOEC for C. riparius. For comparison, also the equilibrium partitioning method was used to derive an EQS_{soil} from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQS_{soil,eq} of 0.016 mg/kg dw. Without this AF, the EQS_{bioav} would be in the same order of magnitude as the calculated EQS_{soil,eq}. Based on our EQS update we strongly recommend to revise the current EQS values for CPY.

**TU198 Lead exposures in European Freshwaters: are they a risk? A regulatory assessment accounting for bioavailability**

I. Wilson, A. Peters, G. Merrington, wca; I. Chowdhury, International Lead Association / Senior Scientist -Environment

Lead (Pb) is a chemical for which one EQS has been set and is applied across all concentration levels to limit the EQS (Environmental Quality Standard) is used in Europe is through a compliance assessment, effectively a comparison of the measured concentration of the chemical of interest in a water sample and the EQS. An indicative tiered compliance assessment of the Europe-wide bioavailable lead EQS of 1.2 µg L^{-1} (EQSbioavailable) was undertaken according to regulatory freshwater monitoring data from six European member states and FOREGS database. A tiered approach to data comparison is required to determine if lead concentrations should be accounted for, by correcting the measured dissolved metal concentrations in the water sample to a bioavailability-based concentration to be compared to an EQSbioavailable. In Tier 1 measured concentrations were compared against the EQSbioavailable. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon correction (DOC-WFD) approach. The outputs from both approaches were compared to the Biotic Ligand Model (BLM), the final tier in the tiered approach. Lead exposures are relatively low across all regulatory datasets and FOREGS. At Tier 1, only 3.9 % of sites and samples assessed have a dissolved Pb concentration of greater than or equal to EQSbioavailable. The data showed a concentration of greater than 0.5 µg L^{-1} the greatest frequencies of such sites are found in the alps and Norway. The lowest PNEC values for Pb are around 0.5 µg L^{-1}, and the WFQ EQS value of 1.2 µg L^{-1} is equivalent to approximately the 4th percentile of the dataset. The results indicate that the European freshwater bodies with low anthropogenic pressure are unlikely to fail the compliance with the EQS, with the exception of very local situations such as historic mining sites.

**TU199 Assessing compliance of European Freshwaters for copper: accounting for bioavailability**

A. Peters, I. Wilson, G. Merrington, wca; D. Heijerick, ARCHE; S. Baken, European Copper Institute

The importance of accounting for bioavailability in understanding the effects of metals has long been recognised in terms of setting environmentally relevant regulatory limit values. Attempts to deliver practical, routine methods to do so have been limited. For regulatory purposes in Europe an agreed Environmental Quality Standard (EQS) for a substance must be a fixed value: the same EQS is a standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area. Furthermore, the model is receiving increasing interest from the regulatory field as it is expertly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatise on this model framework. In a CEFIC-LRI funded project, we have prepared an extensive e-book on GUTS (which will be available for download, free of charge, January 2018). The book contains a detailed description of the model framework (concepts, underlying assumptions and mathematics) and its historical roots, as well as worked-out case studies, guidance for users of the model (or its results), and the results of a ring test for a range of software implementations. This book is the standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area.

**TU200 Are lead exposures a risk in European freshwaters? A map of EQS compliance assessment accounting for bioavailability**

I. Chowdhury, International Lead Association / Senior Scientist -Environment; A. Peters, I. Wilson, G. Merrington, wca

Lead (Pb) is a priority substance for which the bioavailable Environmental Quality Standard (EQS_{bioavailable}) of 1.2 µg L^{-1} has been set under the European Commission Directive 2013/39/EU for application across all countries in Europe. In the present study, a tiered approach was applied to undertake a compliance assessment of the EQS_{bioavailable} using the FOREGS database that includes paired data for water quality parameters and measured Pb concentrations from freshwater streams and rivers across Europe. In Tier 1 measured dissolved Pb concentrations were directly compared against the EQS_{bioavailable}. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon correction (DOC-WFD) approach. The outputs from both approaches were compared to the chronic Pb Biotic Ligand Model (Pb BLM), the final tier in the tiered approach. The maximum Pb concentration in FOREGS is approximately 11 µg L^{-1}. At Tier 1 screening, only 16 (2.0%) water samples of the whole dataset (n=797) had Pb concentrations that are greater than the EQS of 1.2 µg L^{-1}. The exceedances further decreased to 3 (0.4%) and 1 (0.1%) upon accounting for bioavailability at Tier 2 and 3 respectively. The map of site-specific PNECs (predicted no effect concentrations) as calculated by the Pb BLM identifies that the most sensitive waters in the database are all those with extremely low concentrations of DOC (< 0.5 mg L^{-1}). The greatest frequencies of such sites are found in the alps and Norway. The lowest PNEC values for Pb are around 0.5 µg L^{-1}, and the WFD EQS value of 1.2 µg L^{-1} is equivalent to approximately the 4th percentile of the dataset. The results indicate that the European freshwater bodies with low anthropogenic pressure are unlikely to fail the compliance with the EQS, with the exception of very local situations such as historic mining sites.

**Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)**

T. Jager, DEBbox Research / Dept of Theoretical Biology; R. Ashauer, University of York / Environment

Testing, analysing and predicting the lethal action of chemicals on organisms plays a central role in the fields of ecotoxicology and toxicology, both for scientific and regulatory purposes. The dominant approaches to deal with survival data are descriptive, focussing on standardised tests and simple summary statistics (such as the LC50). Such descriptive methods ignore the fact that lethal effects develop over time, thereby leading to biased assessments and precluding useful predictions to untested exposure scenarios. Making sense of toxic effects over time requires mechanistic models, and, more specifically, the explicit consideration of toxicokinetics and toxicodynamics (TKTD). For the endpoint survival, almost all existing TKTD models can now be viewed as special cases of a more general framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has subsequently gained a large user community. Furthermore, the model is receiving increasing interest from the regulatory field as it is expertly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatise on this model framework. A CEFIC-LRI funded project, we have prepared an extensive e-book on GUTS (which will be available for download, free of charge, January 2018). The book contains a detailed description of the model framework (concepts, underlying assumptions and mathematics) and its historical roots, as well as worked-out case studies, guidance for users of the model (or its results), and the results of a ring test for a range of software implementations. This book is the standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area.
which effects start to appear. Once this threshold is surpassed the amount of effect increases linearly with increasing concentration. In other areas of the risk assessment dose-response modelling and the derivation of reliable dose-response curves has received much focus (see e.g. the new EFSA guidance on benchmark dose modelling). Therefore, it is investigated in the present study if these models can be improved by considering more typical dose-response curves, which often are sigmoidal shaped. It is investigated if the taxonomic group of a dose-response model affects the outcome of an assessment and how the magnitude of predicted effects is affected.

TU203 Investigating toxicokinetics of emerging pollutants (PFASs) in the common copepod (S. solea) from in situ measurements and experimental data on PCBs within a DEB-based modelling approach.

F. Mounier, National Research Institute of Science and Technology for Environment and Agriculture - Irslet / EURAB; V. Loizeau, IFREMER / UR Biogeochemistry and Ecotoxicology; L. Pecquerie, IRD / UMR LEMAR; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; G. Munoz, University de Montréal / Chemistry; H. Budzinski, CNRS / UMR 5805 EPOC; J. Lobry, Irslet / EURAB

In the context of global change, developing mechanistic tools integrating the influence of environmental factors on toxicants bioaccumulation dynamics is required, as organisms will face unprecedented conditions. Mechanistic models based on the Dynamic Energy Budget (DEB) theory are relevant to predict individual responses to environmental factors, such as temperature and food availability, quality and quantity. Moreover, this modelling framework allows including adverse effects (DEB-tox), often based on internal concentration. However, for emerging compounds like PerfluoroAlkyl Substances (PFASs), toxicokinetics calibration is a challenge as their properties are not fully characterized yet and experiments are scarce. We here present the results of a research project at investigating toxicokinetics (TK) of PFASs in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). In this highly fluctuating environment, our goal was to extract information from the large variability observed in the measurements for several polychlorobiphenyls (PCBs) and PFASs. First, we designed environmental scenarios and prioritized environmental sources of inter-individual variability using a mechanistic model calibrated for CB153 thanks to experimental data. As CB153 is poorly biotransformable in fish, its bioaccumulation in juveniles mainly relies on the ingestion of contaminated food. Further, we considered this congener as an additional tracer of potential prey in the wild. Indeed, diet reconstruction from stomach contents and isolate data provided us with contrasted pictures. We propose to solve this issue with a combination of field experiment data and models rooted in Dynamic Energy Budget (DEB) theory. In this talk, we will present the results of our study and discuss the different methods to integrate the DEB theory to the TK data in order to improve our predictions of PFAS bioaccumulation in marine species.

TU204 Investigating metabolic acceleration in dynamic energy budget models of copepods using the ecotoxicological model organism Nitocra spinipes

J. Koch, GhEnToxLab (Ghent University) / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Copepods form an essential part of marine ecosystems and constitute a large portion of animal biomass on earth. Moreover, their small size and short life cycle make them convenient test organisms in ecotoxicity studies. Beside acute toxicity, chronic effects which is required for realistic laboratory research project aiming at investigating toxicokinetic (TK) of PFASs in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). In a highly fluctuating environment, our goal was to extract information from the large variability observed in the measurements for several polychlorobiphenyls (PCBs) and PFASs. First, we designed environmental scenarios and prioritized environmental sources of inter-individual variability using a mechanistic model calibrated for CB153 thanks to experimental data. As CB153 is poorly biotransformable in fish, its bioaccumulation in juveniles mainly relies on the ingestion of contaminated food. Further, we considered this congener as an additional tracer of potential prey in the wild. Indeed, diet reconstruction from stomach contents and isolate data provided us with contrasted pictures. We propose to solve this issue with a combination of field experiment data and models rooted in Dynamic Energy Budget (DEB) theory. In this talk, we will present the results of our study and discuss the different methods to integrate the DEB theory to the TK data in order to improve our predictions of PFAS bioaccumulation in marine species.

TU205 Grey seal physiology and environmental change

J. Desforges, Aarhus University (AU) / bioscience; G.M. Marques, University of Lisbon; K. Kauhala, Natural Resources Institute Finland Luke; K. Harding, University of Gothenburg Sweden

Grey mammals are considered as sentinel species for marine ecosystem health. In the Baltic, grey seals (Halichoerus grypus) can serve this purpose as they are top predators and have shown to respond to anthropogenic and environmental stressors over the past decades. These stressors can influence the physiology and health of grey seals, ultimately leading to individual and population level consequences. Acknowledging the need for mechanistic understandings of stressor effects, we have developed a full lifecycle bioenergetics model for Baltic grey seals using Dynamic Energy Budget (DEB) theory. We use the comprehensive information available in the literature on grey seal energetic traits, reproduction to parameterize and validate our model. Our model accurately predicted grey seal ontology and lifehistory traits, providing one of the first full descriptions of mammalian development in DEB. Recent reports have indicated that climate change effects on sea ice and food web dynamics have impacted grey seal condition (i.e. blubber thickness). We use our model to explore these relationships and confirm if grey seal condition in the Baltic is susceptible to change in food quality_quantity and can lead to down-stream consequences on reproductive success. The results offer new insights into physiology and ecology of Baltic grey seals with the potential to lead to novel approaches for the study of stress ecology and conservation of this species.

TU206 Evaluation of thermal stress on Daphnia magna using oxidative stress and life-history trait parameters

H. JM, J. Na, J. Jung, Korea University / Environmental Science and Ecological Engineering

Present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history trait responses of Daphnia magna in short-term (5 days) and long-term (21 days) exposures. D. magna exposed to 25 °C exhibited continuous higher production of reactive oxygen species (ROS). In short term exposure, glutathione peroxidase (GPx) activity was significantly suppressed in elevated temperature. In contrast, daphnids showed significantly enhanced catalase (CAT) activity. In sublethal temperature increases, energy metabolism is affected and overall growth was suppressed. Lower lipid peroxidation (LPO) level at elevated temperature under prolonged stress and life history suggest that antioxidant enzymes successfully prevented ROS-mediated damage. In addition, exposing D. magna to elevated temperature significantly lengthened time to first brood, brood size, and body length, but induced significantly higher male production (p < 0.05). Reduced body length at elevated temperature induced changes in D. magna. However, life history traits are not the same as growth and reproduction to cope with the thermal stress. Moreover, a multi-generational study was performed to evaluate multigenerational effects of elevated temperature on D. magna.

TU207 Transport-protein metal binding links uptake biodynamics for predicting copper in tilapia

Y. Chen, Kaohsiung Medical University / Biomedical Science and Environmental Biology; W. Chen, Kaohsiung Medical University / Department of Biomedical Science and Environmental Biology; C. Liao, National Taiwan University / Department of Biomedical Science and Environmental Biology; C. Liao, National Taiwan University / Department of Biomedical Science and Environmental Biology

Metal could bind to transport protein, then accumulate in the cellular and tissue. It points out that the metal ion accumulating in target subcellular compartment could reflect the metal toxicity. Copper (Cu) plays an essential role in cellular metabolism of aquatic organisms, but it would cause toxicity with excessive accumulation. The purpose of this study was to conduct the short-term exposure experiment to examine the Cu accumulation in tilapia, then combined with bioavailability and subcellular partitioning to estimate the Cu binding situation and mechanism of toxicity on gill. We developed a mathematical framework that quantified the Cu affinity and the amount of transport protein in different subcellular compartment. Results indicated that Cu accumulation in metabolically active pool (MAP) preferred to organelles than heat denatured protein, and Cu accumulation in metabolically detoxified pool (MDP) was metal rich granule. The estimated parameters of maximum Cu influx rate, total number of transport protein and affinity constant didn’t have significant differences between MAP and MDP. However, the conditional stability constant of MDP 0.45±0.005 ml g⁻¹ was
significant higher than that of MAP 0.269±0.018 ml µg^-1 (p < 0.001), and the uptake rate constant of MDP 0.128±0.001 ml g^-1 hr^-1 was also significantly greater than that of MAP 0.086±0.001 ml g^-1 hr^-1 (p < 0.001), it revealed that Cu was likely to bind on MDP in the low exposure concentration than that of MAP. This study concluded that Cu tend to accumulate in MDP, then may cause less toxicity to tilapia. Keywords: Copper; bioavailability; transport protein; subcellular partitioning

TU208

Relationships between subcellular metal partitioning and biomarkers of effects in white suckers (Catostomus commersonii) exposed to an environmental metal gradient

N. Urien, INRS-ETE / Centre Eau Terre Environnement; A. Urien, Université du Québec en Outaouais / Centre Eau Terre Environnement; L. Ramol, H. Sonnenberg, Ecological and Regulatory Solutions Inc; P.G. Campbell, P. Couture, Université du Québec, INRS / Centre Eau Terre Environnement

Discharges from metal mining operations may lead to metal accumulation and toxicity in aquatic species. Once metals enter cells, they can bind to sensitive components and cause deleterious effects. Nevertheless, metals can also be detoxified by binding to nucleophiles designed to sequester them, limiting their toxicity. The objectives of this study were (i) to assess the subcellular distribution of metals and metalloids (Cd, Cu, Se and Zn) in layers of white suckers exposed to metal-mining effluents, and (ii) to investigate the links between the binding of specific metals to particular subcellular fractions and physiological effects. To this end, mature male and female fish were collected in three lakes downstream from a metal-mining effluent and one lake in a reference area. Subcellular partitioning among putative metal-sensitive fractions (MSF) and biochemically detected fractions (BDM) in layers was determined after differential centrifugation and heat-denaturation steps. In parallel, a suite of biomarkers was investigated ranging from general indicators of energy accumulation to specific indicators of oxidative stress and metabolic or biosynthetic capacities. Total hepatic metal concentrations were similarly higher in exposed fish than in reference fish, with Cu and Se (x10) being accumulated the most. No differences between sexes were observed. Subcellular partitioning of metals was similar among areas but specific to metals; over 70% of the Cd burden was found in the heat-stable cytosolic proteins fraction, which includes metallothioneins. In contrast, the largest contributors to the total Se liver burden were the potentially metal-sensitive heat-denaturable proteins fraction (35%), and the organelles fraction (30%). These results suggest that Cd was well detoxified and regulated by white suckers, whereas the presence of relatively high Se concentrations in the MSF suggests that exposed fish were likely subject to stress. Principal component analysis showed that increasing [Se] in all of the fractions was strongly correlated with lower fish condition and associated with higher liver activity of a stress-related biomarker, indicating their oxidative stress. Finally, this work will contribute to advancing our understanding of the toxic modes of action of metals in aquatic organisms and our capacity to monitor the risk for fish inhabiting metal-contaminated environments.

TU209

Development of an adverse outcome pathway for acetylcholinesterase inhibition in zebrafish (Danio rerio)

K.H. Watanabe, A. Mikhail, Arizona State University / School of Mathematical and Natural Sciences; K. Conrow, Arizona State University; N. Vinas, Mississippi State University / Engineer Research and Development Center

Acetylcholinesterase is a neurotransmitter that is important for a broad range of processes in the body such as muscle activation. Acetylcholinesterase (AChE) is an enzyme that hydrolyzes acetylcholine in order to eliminate it from the body, and when AChE is inhibited acetylcholine levels increase. Excess acetylcholine at cholinergic terminals can cause deleterious effects. Nevertheless, metals can also be detoxified by binding to nucleophiles designed to sequester them, limiting their toxicity.

The pituitary gland is a complex organ, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonad development, sex steroid synthesis and gamete maturation. Despite its central role in regulating reproduction, there are limited data on impacts of endocrine disrupting chemicals (EDCs) on the pituitary gland. We have previously observed that waterborne exposure of previtellogenic coho salmon to 17α-ethinylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fsbh) mRNA levels. These results motivated us to expand our studies by developing an in vitro test characterizing endocrine disrupting compounds (PBTK) model for European eels to account for the impact of changes in physiology that result from sexual maturation and migration on toxicokinetics, and (b) to couple this model with a quantitative adverse outcome pathway (qAOP) for activation of the aryl hydrocarbon receptor 2 (AHR2) of fishes to predict early life stage mortality of eels as a result of exposure to maternally transferred DLCs. The PBTK model was used to kinetically predict the redistribution of DLCs within the body of female eels during migration, and ultimately the concentration in gonads and eggs. A simple qAOP was described previously linking activation of species-specific AHR2 with aryl hydrocarbon receptor nuclear translocator (ARNT) and early-life stage mortality of eels. To this end, AHR2 was cloned from European eel and used to predict eel-specific relative potencies of five DLCs representing congeners measured at among the greatest concentrations in gonads of eels. Using this data, mortality of early life stages of eels was estimated based on the internal concentrations predicted by the PBTK model and qAOP approach will ultimately shed light on the question whether early life stage mortality induced by exposure to DLCs has the potential to significantly contribute to the observed decline in recruitment of eels.

TU212

Salmonid pituitary cells as a test system for identifying endocrine disrupting compounds

L. Harding, University of Washington / Aquatic and Fishery Sciences; I.R. Schultz, NOAA NWFSC / Marine Science Laboratory; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; P. Swanson, NOAA-NWFSC

The pituitary gland is a complex organ, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonadal development, sex steroid synthesis and gamete maturation. Despite its central role in regulating reproduction, there are limited data on impacts of endocrine disrupting chemicals (EDCs) on the pituitary gland. We have previously observed that waterborne exposure of previtellogenic coho salmon to 17α-ethinylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fsbh) mRNA levels. These results motivated us to expand our studies by developing an in vitro test
Integrating life cycle approaches towards a sustainable circular economy (P)

TU214 Metal and mineral resources in LCIA - What's the problem? R. Schulze, University of Leiden / CML; J. Guinee, University of Leiden / Institute of Environmental Sciences; R.A. Alvarenga, Z. Weng, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; J. Drielsma, Erasmus University, Rotterdam.

The currently a lack of consensus on how to assess impacts from abiotic resource use in life cycle impact assessment (LCIA). Unlike other environmental impact categories, abiotic resource use does not just have one, explicitly agreed-upon, international management goal. The SUPRIM project focuses on impacts which occur directly from the use of abiotic resources such as minerals, metals, and natural materials. It concerns impacts associated with their availability or accessibility, but excludes impacts covered by other impact categories, such as toxic emissions or adverse working conditions. The current state-of-the-art LCIA for abiotic resources has been criticized by representatives of the metals & mining industry. The LCA community is developing new methods, which all focus on different issues associated with resource use. This lack of a broadly accepted method, likely attributable to the lack of a common perspective on resource use and a common understanding of the potential problem(s) related to the use of resources, was the starting point of SUPRIM. The aim of the project is to obtain an understanding of different stakeholders’ views and concerns regarding potential issues associated with the use of resources. The gained insights are provided in the form of a structured overview of those views, and used as a basis for further method development. They are achieved by ‘taking a step back’ towards a structured discussion about potential problems with resource use, and different motivations behind resource management concepts. To guide the discussion towards a clear outcome, a framework was developed. It introduces distinctive criteria for the evaluation and/or formulation of perspectives and problems on resource use, which will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders from industry, policy and academia. The workshop outcome will be used to guide the further development of impact assessment from abiotic resource use in LCIA, such as a reduced future availability of the resources themselves, changes to their ability to provide functions, losses of certain desired properties in the environment or the technosphere, or an increased difficulty to access them. We aim to present both the framework developed for the formulation and evaluation of perspectives and the outcome of its first application during the stakeholder workshop.

TU215 The relevance of the end-of-life stage for the environmental impact of batteries J.P. Peters, Karlsruhe Institute of Technology KIT / Helmholtz Institute Ulm HHI; M. Weil, University of Modena Reggio Emilia; A. R. Alvarenga, Institute for Technology Assessment and Systems Analysis; C. Minke, Technische Universität Clausthal / Energy Research Center; M. Weil, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Numerous LCA studies exist in the field of energy storage, especially batteries. However, the majority of these studies focus on the production and use phase, while the battery disposal or recycling is usually evaluated in separate studies that focus explicitly on this part of the life cycle. While of lower importance when comparing very similar batteries (e.g., different lithium-ion batteries (LIB)) with similar end-of-life (EoL) processes, this is increasingly relevant when comparing different electrochemical energy storage technologies. Thus, a thorough modelling of the EoL phase can be considered mandatory for a well-funded assessment. For evaluating this aspect we expand existing LCA studies on stationary batteries by a tentative modelling of their EoL processes (recycling) and compare the results. Three different battery technologies are considered for this purpose, an LFP-LTO battery (renewable-made substitute, house), a hybrid aqueous ion battery (AHIB) and a vanadium redox flow battery (VRFB), all with their own recycling and recovery. The results show that considering the end-of-life stage actually does change the outcomes of the results significantly and that cradle-to-gate assessments are not appropriate for comparing very different battery technologies. Highly integrated batteries like the LIB have advantages under a cradle-to-gate perspective (higher energy density and thus lower material demand per provided capacity), while less integrated systems can have significant advantages when it comes to recyclability. The AHIB and VRFB are easy to dismantle and all major components can be recovered by mechanical dismantling on a macro-scale. The highly integrated LIB require complex processes and obtain a commingled fraction of micro-size particles that are difficult to separate and require significant process inputs while only regenerating a fraction of the materials originally contained in the batteries. This can change the picture fundamentally towards an advantage of technologies easy to dismantle on macro-scale (AHIB and VRFB) in comparison with highly integrated cells (LIB). Thus, design for recyclability is highly important in terms of future circular economy and might easily outweigh the possibly reduced energy density or lower performance.
TU219
The impact of European consumption of household appliances: insights from the LCA of efficiency measures and expected trends
F. Reale, EC JRC; V. Castellani, European Commission - Joint Research Centre / Sustainable Resources, Bio-Economy; B. Hasche, EMPA / Technology and Society Lab; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
Household appliances are an important contributor to the overall impact generated by European citizens’ consumption of products. In 2010 the energy-related products covered by the Ecodesign directive responsible for 53% of total EU-28 greenhouse gas (GHG) emissions. The analysis of impacts from the Life Cycle Assessment (LCA) of future scenarios of the European consumption of household appliances in the residential sector. The consumption is a Basket of Products (BoP) owned by an average European citizen. The BoP baseline consists of a process-based LCI model for a BoP that represents the most relevant household appliances in terms of energy consumption and market share: dishwasher, washing machine, drying machine, air conditioner, refrigerator, TV screen, computer, lighting, cooking appliances. A number of scenarios have been tested, covering the various life cycle stages including scenarios on the use phase, the waste collection, the electricity mix used. An overall scenario covering the design options for products energy efficiency and expected trends in purchase and user behavior has been calculated and compared with the baseline. The baseline heat output equation (with LCID impact assessment method) confirmed the well-known relevance of the use phase of energy-related products, where the efficiency of products and consumer behaviour appear to be the two factors determining the BoP impact. Results of the scenarios assessed showed for most of the categories a reduction of the overall impact compared to the baseline scenario. The reduction is more important for categories such as e.g. GWP (due to the improved energy efficiency of appliances), IRP (due to the assumed “phasing out” of nuclear power plants in Europe) and AP (in this case, the reduction of the amount of coal-based electricity leads to reduced releases to the atmosphere of those substances contributing to AP). Due to the expected increase of the number of devices per person in the future, some of the impact categories – namely HTP, PFTP, LUC and FRD – show a higher potential impact in the scenarios than it is in the baseline. Obtained results show clearly that just heading for more efficient devices is a necessary, but not yet a sufficient condition towards more sustainability; we as a society have also to re-evaluate the way we acquire (more and more) such devices and are spending more and more time behind them – here some limitations may would make sense.

TU220
Assessing economic and environmental effects of product replacement program using dynamic discrete choice model: As a case study of “home appliance eco-point system” in Japan
D. Nishijima, National Institute for Environmental Studies; S. Kagawa, Kyushu University; M. Oguchi, K. Nansai, National Institute for Environmental Studies In this study, we evaluated the environmental and economic impacts of “home appliance eco-point system” in Japan which was conducted during a period from May 2009 to March 2011 for encouraging consumers to replace their own products with new ones. Following the proceeding studies (Rust, 1987; Gordon, 2009;), we constructed the product replacement model of air conditioners in Japan by Bellman equation and a dynamic discrete choice model. We also estimated the logistic parameters by the maximum likelihood estimation. We used the annual sales and replacement data of air conditioners during 1993 to 2015 (The Japan Refrigeration and Air Conditioning Industry Association; The Japan Electrical Manufacturers’ Association) and replacement and running cost data during the same period (Agency for Natural Resources and Energy of Japan; The Japan Refrigeration and Air Conditioning Industry Association). Using the estimated product replacement model, we analyzed the impact of “Home appliance eco-point system” on the CO2 emissions and economic output by input-output framework. Through the results, we not only evaluated how effective the system was for reducing CO2 emissions and stimulating economy in Japan, but discuss how we could improve the system for obtaining more economic and environmental benefits.

TU221
Economic lifetime, hazard functions, and car inspection system
Y. Nakamato, S. Kagawa, Kyushu University
Under the Paris Agreement adopted at COP21, Japan set itself a target of reducing its territorial greenhouse gas emissions by 26% (relative to the 2013 level) by 2030. To further reduce emissions in the transport sector, the government has set up both a technology policy and a demand policy, to try to improve the fuel economy of new vehicles and increase sales of next-generation motor vehicles as a proportion of new vehicle sales, respectively [Ministry of Land, Infrastructure, Transport and Tourism, 2017]. In By assessing and estimating the economic lifetime of vehicles on consumer behavior that maximizes utility level over time, we were able not only to specify the replacement purchase rates on a dynamic discrete choice model but also to quantitatively analyze the environmental impact of changes in consumer behavior due to the adoption of policies because a motor vehicle inspection dummy, maintenance and repair costs, and new vehicle replacement purchase costs are explicitly included in the utility functions at the time of vehicle replacement and purchase. In this paper, we built a dynamic discrete choice model to estimate car replacement purchase rates based on consumer behavior aimed at maximizing utility levels over time. By combining replacement purchase rates specified from source data with life-cycle CO2 emissions analysis, we demonstrated the impact of Japan’s car inspection system on CO2 emissions derived from cars. The parameter estimate results obtained from our DDC model are robust, showing that car owners behave with a forward-looking perspective. In addition, it is clear that offering subsidies for car inspection costs can be expected to have a substantial effect on cutting CO2 emissions associated with the transport sector because it would dampen car replacement purchase behavior and thereby increase the average economic lifetime of cars. In The results of this study show that revising Japan’s car inspection system has the potential to cause a major turnaround in environmental performance. In the case of a gradual reduction of new CO2 emissions contributing to cutting CO2 emissions. However, in practice, completely scrapping the current car inspection system would be very difficult. This is because, although abolishing inspections would relieve car owners of a painful cost burden, it might also put the safety of car operation at risk, due to the failure to detect problems that a car inspection would ordinarily detect.

TU222
Li-S batteries for electric vehicles, challenges for circular economy objectives
C. Benveniste, C. Corcho, EREC; B. Amante, Universitat Politècnica de Catalunya
The continuous and planned increase of the electrification in the transport sector is one of the main drivers of advances in energy storage for electric vehicle (EV) propulsion and present technological challenges to achieve the expected requirements. The implementation of the EVs on our roads remains a challenge and is below expectations foreseen. The elevated costs of the batteries and thus the EV cost, refrain the massive depletion of this technology. With the aim of reaching a full transition of the internal combustion engine to the short term, it is necessary to investigate new materials and configurations of EV batteries. To this end, lithium-sulfur (Li-S) batteries is the closest battery technology capable of meeting these expectations. Although Li-S can overcome the technical issues, this solution still needs to demonstrate how the socio-economic-environmental barriers associated are solved, above all when considering their fitting in a circular economy society. There are no clear evidences of the environmental benefits due to the use of Li-S batteries as an alternative to Li-ion batteries. Moreover, there is still unclear of how these batteries should be treated at the end of life with the aim of recovering the maximum amount of valuable materials. This study focuses on the methodological design to analyze the environmental and social aspects related to Li-S batteries using LCA perspective in a circular economy context. This research has the following objectives: 1) To evaluate their environmental profile; 2) To identify their possible use in a second life, once they cannot be used in an EV (e.g. their use in stationary applications); 3) To evaluate the associated environmental impacts and potential benefits due to material recovering using batteries recycling options. These objectives present a considerable number of challenges due to the lack of data in the Li-S data inventory collection, the uncertainties due to the feasibility of using them in second life and the lack of examples to analyze economic and environmental benefits of designing a customized recycling process. For this reason, the aspects covered by this study are extremely relevant in the frame of considering Li-S batteries technology as a suitable system within the objectives of a circular economy. This research is being carried out within HELIS Project. This project receives funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement No 666221.

TU223
ATISOL. C2C - Life cycle assessment as a tool for the ecoscaling of a “vapour and air barrier membrane - insulator” system, in a cradle to cradle approach (TU224) Lasting, but not beautiful. The Chemical Brenda of the 19th. Technical Chemical Engineering - PEPs; M. Getlichcrman, Derbigum; B. Colson, Sfoon Fett & Filtration; I. De Vilder, Centexbel; A. Tilman, Belgian Building Research Institute (BBRI); A. Léonard, Liège Université / Chemical Engineering - PEPs
The European directive on the energy efficiency of buildings requires the members to put on the market solutions for insulation of buildings that are simple, effective and lasting, but also respectful of the environment (The 2010/31/EC Directive). With the aim to reduce energy losses and to guarantee the durability of the thermal insulation, it is necessary to have a vapour and air barrier on the warm side of the building, situated between the thermal insulation and the inside. Hence the passage of moisture from
the building is reduced, preventing condensation problems on the insulating material. Currently, the implementation of an insulation system combined with a vapor barrier presents three major problems: an important time for placing, a random durability in time (stability of tapes of junction, adherence to the existing walls, punching resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + recycling + economical valorization), with the lowest environmental impact on its whole life cycle. The solution can be used in both new construction and renovation. Compared to the state of the art, the solution that is developed is unique and innovative by its simplicity in terms of materials by integration of a vegetal self-adhesive binder to the spunbond reinforcement of the membrane, the latter being also made of renewable resources. The material is appropriate for application on any different wall covering but can be used as a coating for roofs. Due to the self-adhesive characteristics, the implementation is made easier in both common surfaces (walls, roofs and ceilings) and to the level of detail such as corners and junctions. In addition, the application of a clay finishing coating on the membrane completes the offer. The constructive system can be dismantled at the end-of-life of the building and the various elements are recovered and valued in a cradle-to-cradle perspective. A first step is already carried out: the ‘Herbitskin’. The preliminary life cycle assessment results support the technical partners along the whole development and evolution of the membrane by pointing out the hotspots of the system, from the choice of the components of the vegetal binder or the spunbond reinforcement to the manufacturing process. This project is supported by the GreenWin Competition Clusters and subsidized by the Walloon Region (BE).

TU224

Life Cycle Assessment of Recycled Asphalt and Biomaterials for Road Pavements
A. Jimenez del Barco Carrion, The University of Nottingham; D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC

Within the ERA-Net PLUS Infravation 2014 Call, the project BioRePavation analysed three alternative biomaterials to be included in high-recycled asphalt content mixtures to help increase recycling rates in an European case study. A comparative full Life Cycle Assessment of the asphalt pavements was carried out for each alternative to determine whether the use of recycled asphalt mixture in high amounts including biomaterials still entails environmental advantages. From a preliminary analysis of the results, it is possible to affirm that using the asphalt mixture with high recycled content in pavements improves environment performance than the asphalt mixes currently used in Europe. This type of studies are needed in order to encourage road authorities to use innovative technologies that can promote a circular economy.

TI225

Dynamic vs static LCA to explore the sustainability of industrial waste recycling
A. Di Maria, KU Leuven / MTM; A. Levasseur, École de technologie supérieure / Construction engineering; K. Van Acker, KU Leuven / Materials Engineering

LCA methodology is often used to promote the circular economy in the construction sector. However, that case seems to be an exception when assessing the environmental impacts of building and construction materials. Construction materials can accumulate in buildings and infrastructures for several decades, with considerable stocks of materials along the life cycle. Due to the long life of construction materials, LCA should take into consideration also time related aspects. However, in the current LCA, any temporal information is lost, making static LCA strategies better suited for retrospective assessment rather than forecasting purposes. To fill this gap, this study proposes a time-dependent LCIA on climate change, to assess the carbon footprint of two newly developed construction materials, produced through the recycling of industrial residues (stainless steel slag and industrial goethite). The results of the dynamic LCA are compared to the results of traditional static LCA, to see how the methodological development of dynamic LCA may have an influence on the final environmental evaluation for construction materials. Both dynamic and static LCA results show that the recycling of industrial residues to produce new construction materials has the potential to mitigate the climate change impacts of construction blocks, by substituting traditional OPC concrete. Although the dynamic LCA did not result in a shift in the ranking between the three materials compared with static LCA, it provides a clearer picture on emission flows and their effect on climate change over time.

TU226

Pursuing the sustainable circular city - is environmental accounting supporting the transition?
A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

The transition from linear to circular economies is already in the international policy agenda and several actors are implementing this concept at different scales. In particular, cities are engaged in this process in the quest of becoming healthier, more sustainable environments, and they thus promote a number of circular initiatives. However, do these initiatives help to achieve the goals included in local sustainability agendas? Or are they less environmentally favorable than conventional, linear systems? Systematic environmental accounting might give an answer to these questions once decision-makers have access to practice-oriented strategies. In this contribution, we seek to determine whether research has effectively quantified the environmental performance of the initiatives promoted in cities. To do so, we gathered the features of circular economy initiatives reported by a pool of cities to understand what they refer to when addressing circular economy. At the same time, we reviewed scientific literature that applied quantitative environmental tools to analyze case studies of circular economy practices. These tools included life cycle assessment, recycling and cascade use of resources. To address how the research gaps regarding the impacts of new strategies and a structured evaluation is needed. While research and practice are both interested in the implementation and evaluation of waste management practices, cities are engaged in a variety of initiatives that research has not explored yet, such as urban planning issues. This might put cities at a disadvantage if they are not able to select the most environmentally friendly initiatives that help them achieve their local sustainability goals while approaching circular economy.

TU227

Taking stock of a circular economy within planetary boundaries: A multi-scale analysis through consequential LCA
H. Helder, A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

Current institutional agendas are embracing the concept of “circular economy” (CE) in order to improve the sustainability of products and services and reduce the resource dependence. CE is applied through a broad range of strategies at various scales, from production level, to the city level, to the national level. Despite the different CE strategies such as eco-design, recycling and cascade use of resources, as well as on European cities applying CE-related strategies. At the city level, CLCA will be combined with territorial LCA to provide information on the environmental variations associated with local CE strategies. Thus, we might be able to determine the impacts of production and consumption activities that meet the needs of a city before and after the application of CE strategies. At the product level, case studies will examine different CE strategies such as eco-design, recycling and cascade use of resources. To address how sustainability changes with scale, sector-wide scenarios for different measures and changes in market shares will be constructed through a CLCA approach. Opportunities and challenges for the specific sector and context will be identified to include side effects and to ensure assessing realistic pathways. In this way, the framework adapts to the specific requirements of each sector, to interpret the results in relation to the safe operating space, the planetary boundaries will provide reduction targets. This will be done by following existing proposals on the integration of LCA results into the planetary boundaries approach. By combining a bottom-up CLCA approach with a top-down planetary boundary framework, we provide a method that can take stock of “real” environmental sustainability progress, at different scales and thereby help companies, cities and countries to understand the environmental implications of CE strategies. This might enable the integration of environmentally friendly CE initiatives into a variety of sectors and scales.

TU228

Opportunities and threats in water treatment options as investigated by LCA
T. van den Brand, KWR Watercycle Research Institute / Water systems and technology; R. Hofman-Caris, KWR Watercycle Research Institute; A. Butkovskiy, Wageningen University WUR; B. Hofs, Evides Waterbedrijf; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; S. Koole, KWR Watercycle Research Institute

In this research two LCA studies are presented as starting points in studies on water treatment processes. Case 1 on drinking water production and case 2 on industrial wastewater treatment. Both cases were aimed to unfold the potential of LCA as a...
tool to direct future research. We performed the work using Simapro 8.0 software, method Recipe Endpoint (E) and the Ecoinvent 3.0 database. First, in drinking water production, flocculants are used to remove particles, natural organic matter (NOM) and metals (like iron) from water. The sludge formed can be hydrolysed again to recover iron for production of new flocculants. Our LCA study showed that flocculants obtained from iron sludge after HCl dosage have a significant lower environmental impact than commercial and other flocculants. The LCA study of flocculants from iron sludge is applied in the drinking water purification or waste water treatment looks promising and this LCA study underlined that technical research into the quality of the flocculants is justified. A sensitivity analysis indicated that the iron content of the sludge is strongly determining the environmental impact; thus indicating that different types of iron sludge should be considered for further research. As second case study, we investigated water management in shale gas production, since hydraulic fracturing technologies require significant volumes of water for well development and produce huge volumes of wastewater with highly variable composition. Different treatment options for waste water from shale gas production were compared in case 2. It is important to note that each process resulted in different effluent quality. Each process included a pre-treatment step consisting of dissolved air flotation and biogeadation, followed by either discharge directly to seawater, or treatment with vapour compression distillation (VCD) with water discharge to surface water and injection of the brine back to the deep underground formation. The LCA study on of shale gas waste water treatment indicated that more detailed information on the concentrations of compounds in the waste water is required. A technical research into the efficiency of the VCD, to optimise compound removal from waste water is recommended. In this study LCA has shown to be an effective tool to evaluate the direction of research within the water sector, evaluate possibilities for resource recovery and determine environmental impacts of processes.

TU229 Closing the loop in a territory: LCA approaches to boost resource recovery M. Calvet, CETauqa / MASE; M. Amores Barrero, CETauqa, Water Technology Centre; D. Marin, CETauqa, Water Technology Centre / Environment and Socioeconomics; M. Isasa, CETauqa Water Technology Centre / MASE; M. Termes, CETauqa; M. Ruiz Mateo, CETauqa Water Technology Centre The concept of Circular Economy is widely extended in political and business agendas and so is the concept of "Closing the loops". The idea that the value of materials and products should be maintained in the economy as long as possible and wastes minimised is understood and accepted. However, its implementation is bringing to the light questions as to which level to implement it (material, product, system, business and territory), which tools to use to decide on the most appropriate circular economy approach to adopt (e.g. product design, circular business models, etc.). Besides, non-governmental organisations, municipalities and wider geographical areas, act as accumulators of resources that in the current linear model create negative externalities. However, these waste and energy flows if managed in a circular system could be valorised bringing massive opportunities to all territorial actors. This paper explores the application of the Circular Economy in two different case studies in Spain (San Feliu de Llobregat an the Territorial Circular Model) and on a national level (Spain), for which a methodology has been specifically created. The methodology is validated and its effectiveness demonstrated through the identification of more than 10 Circular Economy Opportunities in each case study. The role of LCA as a tool used in different stages of the Territorial Circular Model is explored i.e. at the data inventory gathering, resource flows analysis, assessment of the most appropriate circular economy strategies and the identification of indicators to establish current levels of circularity and benchmarks. The need to develop a tool to assist in the data inventory gathering, data visualisation and material flows analysis to identify a greater number of circular economy opportunities is also highlighted. Conclusions of the research include the need to assess the identified opportunities from a technical, economic and social perspective. The importance of the development of an action plan to assist actors in the implementation of the preferred circular economy strategy is highlighted. Finally, the importance of monitoring of the assessed impacts of the strategy is emphasised.

TU230 Innovative method to optimize territorial organic waste resources G.C. Vega, The Technical University of Denmark (DTU) / Management Engineering; J. Sohn, The Technical University of Denmark DTU / DTU Management Engineering; M. Birkved, Technical University of Denmark / QSA Dept of Management Engg A truly environmentally sustainable bioeconomy requires integrative approaches for both design and implementation of the circular economy strategy. A holistic system approach is taken into account in order to arrive at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCAs of biotechnologies with analysis of producer territories in order to provide site specific recommendations that take into consideration different geographical and feasibility constraints, the present and future energy grid, and production capabilities. The authors posit that a multi-criteria approach, such as this, can prevent unforeseen burden shifting between environmental impacts while providing implementable decision support. Method: An LCA of various biotechnologies will be conducted with the aim to provide guidance for bioenergfy ecosdesign that would incorporate emerging biotechnologies and cascading products. Among these technologies, six pathways for anaerobic digestion (AD) and three different pathways to extract polyphenols will be assessed at the product level. At the territorial level a two-pronged approach will be used to achieve a representative data set for the territories, which will consist of material flow data from national and regional sources scaled down to the territory and individual producer data (primary production) added up to the territory level. A feedback loop is established between the modules of biotechnology assessment and the foreground system at the level of the territory, in order to observe the effects of waste optimization on the territory. Results: The performance of the biotechnologies will very likely depend largely on energy consumption and the intended use of the new products viz. how the residual resources from wine production are used. At the territorial level the authors posit that local managerial practices, in terms of wine production will be greatly influencial for global warming, eutrophication and resource depletion potentials. Fertilizer inputs, both mineral and organic, and pesticide use will very likely differ from territory to territory and will impact the above mentioned categories as well as toxicity related impact categories. Another important aspect will be the energy consumption of the territories and the influence of future energy grid greening on the future impacts of the technologies proposed today.

TU231 Environmental Benefits of a Circular Economy: Connecting Waste Type and Geographic Proximity R. Itten, K. Kelley, M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences The aim of a circular economy is to transform waste into resources. There is a plethora of waste and by-products that remain unused in the traditional linear industrial system. However, transformation from a linear to a circular system is challenging, limited by several constraints such as the availability of information on the specific composition of the waste, the availability in time and space in quantity of waste as well as limited knowledge of the usability of such waste products. The goal of the SHAREBOX Horizon 2020 project is the development of a platform for the facilitation of synergies within the industry to enable a more circular flow of resources within the European processing industries. The SHAREBOX platform is a database of available waste and resources required by companies, enabling the transformation of waste to resources by matching supply and demand. The platform also serves as the first point of contact between different partners in a circular system. Furthermore, the platform enables the identification of new synergies overarching the different subsectors of the industries as well as optimal matching from the perspective of a circular economy. We analysed the implications of the transformation of different types of waste to resources when the industries are located in different geographic locations under consideration of the life cycle stage of transformation. Waste PET can be transported up to 10 000 km by lorry and still provide a net benefit regarding greenhouse gas emissions due to circular use. However, in case of concrete, the results are very different. A net benefit only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems can substantially reduce total resource consumption as well as emissions of the whole value chain and therefore contribute to a greener economy. However, matching industries for transformations leading to the substitution of primary materials is still a major challenge. In addition, the environmental benefits of the reuse of resources is limited by the life cycle stage of the transformation as well as by additional transportation that may be required. The completeness of the scope will be crucial for the assessment and generalisations overarching different types of waste remain challenging.

TU232 Evaluation of nutrients and energy recovery technologies through Life Cycle approaches M. Ruiz Mateo, CETauqa Water Technology Centre; M. Calvet, CETauqa / MASE; S. Lopez, CETauqa Water Technology Centre / Sanitation; M. Isasa, CETauqa Water Technology Centre / MASE; Y. Lorenzo-Toja, CETauqa, Water Technology Centre; D. Marin, CETauqa Water Technology Centre / Environment and Socioeconomics Conventional treatments for wastewater treatment are characterized by a high energy consumption, mainly attributed to the oxidation (removal) of carbon and nutrients. In the current economic and environmental context, there is a necessity to find solutions and provide strategies and technologies to be able to change the current concept of Waste Water Treatment Plants (WWTPs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the fermentation industry to produce biofuels and other chemicals from the finite reserves of phosphate rock, that moreover, are located out of Europe. The LIFE NECOVERY project aims at demonstrating, by means of a prototype, the feasibility of a new wastewater treatment approach, based on energy and nutrients recovery. The process tested in the project is based on an initial pre-concentration step that promotes the biosorption process maximizing the biogas production. The effluent of the pre-concentration unit is the influent of a nutrient recovery unit based on adsorption in zeolites. The LIFE ENRICH project (Enhanced Nitrogen and Phosphorus Recovery from wastewater and Integration in the value CHain) goes a step further and aims at demonstrating the whole value chain for nutrient recovery
in wastewater treatment plants and their valorisation in agriculture through different approaches boosting a model based on circular economy. This study intends to evaluate environmentally and economically the innovative processes tested in the LIFE RECOVERY and LIFE ENRICH projects by comparing them to conventional schemes of wastewater treatment. To do so, Life Cycle Assessment (LCA) has been the selected methodology to quantify the environmental burdens of the innovative and conventional treatment processes. The cases under analysis are located: Vilanova WWTP and Murcia Este WWTP. Special focus has been put to impact on climate change, which is expected to be reduced thanks to the recovery of nutrients that could replace chemical fertilizers and due to the higher biogas production and its further valorisation. Life Cycle Costing (LCC) analysis has been undertaken in order to assess all relevant costs associated with the life cycle of both systems and to evaluate the cost incurred (CAPEX and civil works) and operation and maintenance phase (OPEX costs e.g. energy, chemicals, transport) and is aimed to identify the most economic-friendly scheme.

TU23 Life Cycle Assessment of a novel process of polyhydroxyalkanoates production with waste and by-products from wine industry value chain A. Novi, Università di Bologna / Centro Interdipartimentale di Ricerca per le Scienze Ambientali; L. Vogli, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; S. Righi, University of Bologna / Physics; S. Macrelli, R. Conti, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; C. Samori, C. Torri, Università di Bologna / Linguistica; L. Ladu, Technische Universität Berlin; A. Koutinas, Agricultural university including pyrolysis. No significant differences between the two feedstock used are technologically simpler and therefore more efficiently than the setup without pyrolysis. The latter, on the other hand, is able to accumulate polyhydroxyalkanoates (PHAs) granules as carbon and energy intracellular reserve. The knowledge of these parameters permits the identification of those elements that influence its magnitude, so that, different alternatives can be used to enable the sustainability of the oil palm industry. Finally, this research could contribute to develop new sustainable products based on palm oil for food and non-food applications. In addition, the aim of this research is to develop the circular economy approach in the Colombian palm oil industry, to account for the agriculture supplies and demands in a representative sample of the process chain. This study allows the characterization of the quantity of waste to be used in palm oil mill bio-refineries as a representative sample in order to identify potential risks. In addition, the work adds not only criteria for assessing the agricultural palm sector to establish indicators for a sustainable circular economy, but also methodologies based on Life Cycle Analysis to allow efficient management of resources, nutrients and agrochemicals in order to quantify the required amount to produce a given product. The knowledge of these parameters permits the identification of those elements that influence its magnitude, so that, different alternatives can be used to enable the sustainability of the oil palm industry. Finally, this research could contribute to develop new sustainable products based on palm oil for food and non-food applications. In addition, the aim of this research is to develop the circular economy approach in the Colombian palm oil industry, to account for the agriculture supplies and demands in a representative sample of the process chain.

TU23 Integration of a Colombian bio-refinery from industrial palm oil waste into the circular economy J. Torres, Universidad de la Salle / Grupo de Investigación en Gestión del Riesgo y Cambio Climático; I. Herrera, D. Garzín, A. Gamara, CIEMAT / Energy Dept Energy System Development Unit; J. Sanchez, Sustainable Development for future decision making towards the sustainability of resources and the optimization of processes carried out by palm-cultivation companies as part of their policy of environmental responsibility.

TU26 CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOGAS PRODUCTION FROM PALM OIL MILL EFFLUENT N. Abdul Aziz, M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science Exploring renewable energy sources is becoming increasingly important due to its low environmental impacts as compared to the consumption of non-renewable fossil fuel sources. Waste-derived biogas is one of the promising technologies that yields a renewable, sustainable, and green source of energy. In Malaysia, palm oil mill effluent (POME) can be a suitable feedstock for biogas production due to its abundant and high potential in energy generation. However, a comprehensive assessment need to be conducted to ensure the sustainability of POME-based biogas production. This study was conducted to evaluate cradle-to-gate life cycle assessment of a performance system associated with the production of biogas by the anaerobic digestion of POME. The functional unit was defined as 1 tonne of POME used for biogas production and the system boundaries covered the plantation-processing mill-biogas plants stage. The life cycle assessment (LCA) was performed using ReCiPe 2016 environmental impact method and SimaPro 8.4 software. The present study demonstrates that the generation of electricity from biogas is advantageous comparing electricity production in conventional power plants. The results also able to identify hotspots in the life cycle of the biogas production where environmental performance of the system can be improved and environmental benefits can be achieved from the anaerobic digestion of POME with regard to the reduction of greenhouse gases emissions.
Ecoinnovazione / LCA and Ecodesign Laboratory; D. Tonon, Ecoinnovazione srl Circular Economy has become a concept quite known also within the public domain. It is a catchy term that puts together two words easily understood by everybody with a positive meaning. Moreover, it can be easily translated into simple rules/guidelines to follow to claim an improvement of our economy and its relation with the environment, such as: recycle, avoid dangerous substances, extend the life of the products. However, the reality is more complex, and there are some serious challenges to overcome. Biodegradable waste streams in other life cycles do not come for free. For example, burden shifts from resource depletion to other environmental impacts are likely and common consequences. For this simple reason, life cycle assessment and life cycle sustainability analysis should be used to support the identification and understanding of the potential advantages of circular economy solutions, while the identification and management of the unavoidable trade-offs. In the case of innovative technologies developed to extract valuable substances from waste streams, the complexities of the analysis are related to: scale-up from laboratory or pilot scale to full industrial scale; different possible industrial applications of the technology; a basket of diverse applications of the innovative semi-finished product/ingredient delivered by the new technology; diversity of the function of the technology: complex market of the substituted products, etc. This work presents and discusses how the above-mentioned challenges and open issues, with a focus on the diversity of the function of the technology, have been addressed in a specific case of an innovative technology to extract polyphenols from different waste streams. The presented example shows that the analysis can be rather complex due to the need of addressing different applications, identifying the key challenges and the fact that the same technology can provide different functions according to the selected perspective. The oral presentation will detail how the main difficulties have been considered and addressed, such as the size-scalable, complex market of substituted products, different geographical location of the technology implementation. One key aspect is that the adopted perspectives directly influence the results in terms of environmental preference of the innovative technology, and as such, the benefits of circularity solutions need to be properly addressed and quantified, and are not inherently beneficial.

TU238 Circular economy: what does restaurant food waste generation data and consumers say? R. Dagilute, Vytautas Magnus University / Environmental Science Department; A. Musteikyté, Vytautas Magnus University Around 88 million t of food is annually wasted in the European Union. According to FAO (2013), 31–39% of food is wasted at consumption level in developed regions. This wastage has an enormous negative impact on the global economy and food availability. Still, the recognition of the negative environmental impacts, EU has introduced “Towards a circular economy: a zero-waste programme for Europe” (COM/2014/0398 final) aims to reduce by half food waste in EU by 2030. Roadmap to a Resource Efficient Europe (COM) (2011) 571 aims to change consumption patterns and achieve 20% reduction in the food chain's resource inputs and halved disposal of edible food waste in the EU by 2020. As study (2008) on British households indicate, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. This study analyses amount of the food waste generated in a restaurant X (Vilnius, Lithuania) and explores consumers’ attitude towards this problem. Catering business was closely monitored in terms of customers’ flows and food waste generated. To find out consumers’ opinion about the waste of the restaurant was done survey. Below shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food waste decreased mostly due to the seasonality. Weekend effect was also registered. Flour products composed the biggest share of all food waste. It was found that the restaurant consumers had low ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take-away left food. 43% of those would reduce portion size to take only what is consumed. Most of respondents were with higher education and higher incomes. Although respondents had no clue on their own negative impact to the environment, they all agree that much more information on solving problems like this is needed. Therefore, policies to encourage food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU239 Assessment of Carbon Footprint of a typical Spanish dietary pattern: The Atlantic diet X. Esteve Llorens, Universidade de Santiago de Compostela / Chemical Engineering; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; J. Garrido, Universidad de Santiago de Compostela; S. González-García, Universidad de Santiago de Compostela CIF Q1518001A Chemical Engineering Access to adequate nutrition is a basic human need that depends on numerous social, political and economic factors. Similarly, food patterns affect not only to food consumption but also its production, which cause health, social and environmental impacts. In particular, food chains that support diets are linked to environmental issues such as greenhouse gas (GHG) emissions, fossil energy requirements and land use. According to Garnett (2011) and Irz et al. (2016), 15-30% of total GHG emissions in developed countries are derived from food production, distribution and consumption. Therefore, environmental pressures from food systems are on the top of public agendas, and sustainable food production and dietary patterns are considered of major interest. Consumption patterns vary significantly across Europe. In the southern countries, healthier diets richer in fruits and vegetables have been identified. In this sense, the traditional Atlantic diet is a common dietary pattern in Northern Portugal and Galicia (Northwest of Spain), culturally and climatic similar areas. The Atlantic diet is characterised by an abundant consumption of vegetables, fish and meat, mainly local and fresh products (seasonal food), cooked to maintain its characteristic flavour and taste. For this reason, it has become a worldwide reference for a healthy diet. The main objective of this work was to quantify the carbon footprint of the Atlantic diet using a simplified Life Cycle Assessment (LCA) approach due to the lack of detail at certain stages of the life cycles of various foods. To do so, the production, transport and processing (when necessary) of the different food ingredients that constitute a typical daily menu was taken into consideration. According to the preliminary results, food production was the main responsible for contributions to the carbon footprint, mostly due to agricultural and livestock activities involved in the production of vegetables, fruit and meat. The findings from this study can be very useful for farmers and food processors to determine the impact of their activities. Moreover and in line with the literature (Pernollet et al., 2017), the use of a simplified LCA method reports accurate results at a lower demand of data collection than the full LCA. This research has been supported by a project granted by Xunta de Galicia (ED431F 2016/001). S.G-G. would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness (RYC-2014-14984).

TU240 Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes? N.A. Charalambous, KU Leuven / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering; J. Eyckmans, KU Leuven / Faculty of Economics and Business The sharing economy, facilitated by digital platforms, is expanding in to more and more areas of the economy and could help the transition to a more circular and sustainable economy. The a priori environmental benefits of sharing arise from providing wider access to assets of higher intensity use and often at lower costs compared to owning goods produced overall. Thus, in order to account for the impacts, goods must be assessed over their entire lifetime, particularly the manufacture and use phases. Life cycle assessment (LCA) is a tool that can be used to estimate such environmental impacts, but a comprehensive assessment should also include the various responses and behavioural changes of consumers to this new sharing marketplace. For example, goods which depend on the use of high carbon intensity material, such as electronics or clothing, can be replaced by more sustainable alternatives through sharing. From an assessment point of view, this means that models need to be adjusted to account for these new behavioural trends. Therefore, in order to properly assess the environmental impacts of sharing, a priori a model should be tested to capture the a posteriori behavioural changes that arise from sharing the economy. Assessing life cycle impacts of the sharing economy: how to account for behavioural changes? (COM/2014/0398 final) aims to reduce by half food waste in EU by 2030. Roadmap to a Resource Efficient Europe (COM) (2011) 571 aims to change consumption patterns and achieve 20% reduction in the food chain's resource inputs and halved disposal of edible food waste in the EU by 2020. As study (2008) on British households indicate, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. This study analyses amount of the food waste generated in a restaurant X (Vilnius, Lithuania) and explores consumers’ attitude towards this problem. Catering business was closely monitored in terms of customers’ flows and food waste generated. To find out consumers’ opinion about the waste of the restaurant was done survey. Below shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food waste decreased mostly due to the seasonality. Weekend effect was also registered. Flour products composed the biggest share of all food waste. It was found that the restaurant consumers had low ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take-away left food. 43% of those would reduce portion size to take only what is consumed. Most of respondents were with higher education and higher incomes. Although respondents had no clue on their own negative impact to the environment, they all agree that much more information on solving problems like this is needed. Therefore, policies to encourage food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU241 Effects of plant growth and organic carbon addition on DDE degradation in soil M. Cardoni, National Research Council of Italy / Water Research Institute; P. del Plata; P. Grenni, National Research Council of Italy / Water Research Institute; N. Ademollo, F. Spataro, National Research Council / Water Research Institute; M. Cardoni, National Research Council of Italy / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute After the use of DDT was banned in numerous Countries several years ago, owing to its high lipophilicity and persistence, this pesticide and its metabolites (p’-DDE and p’’-DDD) are frequently found in the environment. Plant-assisted bioremediation can be a promising clean-up technology to contaminated soil remediation; it relies on the synergistic action between plant rhizosphere and microorganisms to remove toxic substances. In this work, Solanum lycopersicum together with dissolved organic carbon were added to DDE-contaminated soil for bioremediation purposes in greenhouse microcosms. The experimental setup was...
performed to assess the effectiveness on DDE biodegradation of tomato plant presence with and without the addition of two different DOC (with different humic substance composition). The pots were filled with contaminated soil (1 ppm of DDE) in presence/absence of tomato plants and watered with different kinds of DOC solutions; control soils (with/without plant and/or DDE) were also implemented. The plots were sampled after 40 days from DDE exposure. The effectiveness of the effect of the presence of tomato plants on the microbial community and on DDE biodegradation ability were evaluated in terms of microbial abundance, viability, structure, dehydrogenase activity and DDE residual concentration. The results showed that the plant presence stimulated the overall soil microbial community activity but did not increase significantly the DDE biodegradation. The quality of the organic carbon in terms of fulvic and humic acids presence influenced differently both DDE degradation and microbial activity.

**TU242**

**Soil microbial community associated to a poplar-assisted bioremediation study**


A poplar-assisted bioremediation strategy has been applying for four years to a historically polychlorinated biphenyls (PCBs) contaminated area in Southern Italy using the Monviso poplar clone. This clone was effective in promoting both a general decrease in contaminant occurrence and an increase in microbial activity in the chronically polluted area. The experiments showed that the extent of the contaminated area has been reduced in terms of overall PCBs concentration under the Italian legal limit (D.Lgs. 152/06) of 60 ng/g soil (Ancona et al., 2018). A further sampling was performed four year later in order to assess the PCB residual concentrations at different locations and distance from poplar tree trunks inside the planting area. At the same time, microbial analyses were carried out to monitor the overall microbial community activity and compare the PCB degradation in soil samples collected from different depths and distances from poplar tree trunks inside the planting area. At the same time, microbial analyses were carried out to monitor the overall microbial community activity and compare the PCB degradation in soil samples collected from different depths and distances from poplar tree trunks inside the planting area.

**TU243**

**Plant-assisted bioremediation to recover multi-contaminated areas and provide biomass for renewable energy production**


Phytoremediation is gaining popularity as a sustainable solution to contaminated soil remediation. In particular, plant-assisted bioremediation exploits synergistic action between plant roots and natural microorganisms (bacteria and fungi) to remove, transform or stabilize toxic substances in soil, sediment or water. Such remediation technology can be effectively applied to contaminated areas. It is based on the use of suitable plant species, selected to stimulate the biodegradation activity of the rhizosphere microorganisms (e.g. through the production of radical exudates or oxygen release). The plant-assisted bioremediation is an environmental recovery strategy for areas affected by widespread and multiple contamination, ecologically and economically viable. At the same time, this technology can provide wood biomass that can be efficiently treated to produce renewable energy. Among these treatments, biomass gasification is a very efficient process to produce clean energy in the form of a fuel gas (syngas). Among plant species poplar has good energy production potential, can grow in different environments and it is among the fastest growing trees. Furthermore, poplar demonstrated the capability to absorb organic contaminants (i.e. heavy metals) from the soil in which it is cultivated. For these reasons, the potential to convert poplar for syngas biogasification, using biomass collected from a plant-assisted remediation area located in a contaminated soil in Southern Italy. The implementation of these technologies is line with the sustainability criteria of the Renewable Energy Directive (EC 2009) and with those of the “circular economy”, according to which by recovering energy from a material that would otherwise be a waste, taking care to separate any hazardous pollutants released during the process. An exhaustive Regulation, which establishes threshold limits of contaminants in the biomass and rules on how to manage it outside the remediation site, is necessary.

**TU244**

**Microcosm experiment to assess the effectiveness of a Populus clone to enhance PCB biodegradation in a historically contaminated soil**

L. Passatore, National Research Council / Institute of Agro-Environmental and Forest Biology (IBAF); A. Barra Caracciolo, National Research Council / Water Research Institute; M. Di Lenola, National Research Council of Italy / Water Research Institute; P. Grenni, National Research Council of Italy (CNR) / Water Research Institute; I. Nogues, National Research Council of Italy / Institute of Agro-Environmental and Forest Biology (IBAF); E. Guerriero, P. Benedetti, National Research Council / Institute of Atmospheric Pollution Research; A. Massacci, Italian National Research Council / IBAF

Greenhouse experiments have been performed to test the capacity of the Populus species (clone Monviso) to grow on a PCB historically contaminated soil and to improve soil quality in terms of contaminant transformation and autochthonous microbial community abundance and activity. The experimental set-up consisted of pots filled with the contaminated soil and poplar cuttings, under the following conditions: microbiologically active soil (TMA), previously sterilized soil (TS), microbiologically active soil in hypoxia (TMAA). Moreover, non-planted soil was used as control. PCB concentrations in soil samples and plant roots were analysed 6 months and 12 months after the start of the experiments. At the same time plant growth, biomass production and plant stress indicators (i.e. chlorophyll content, leaf fluorescence, antioxidant in plant tissues) were investigated together with cell abundance, diversity and viability of soil microorganisms under the different growing conditions. The overall results showed the capability of the clone Monviso to transform and bioremediate PCBs in roots. The PCB transformations were initially higher in the microbiologically active soil; subsequently in line with a high microbial growth of the sterilized soil, the amount of indicator congeners found were similar between the two treatments. The anoxic treatment differed in terms of congeners detected, microbial community structure and activity and plant physiology stress indicators. However, the Monviso clone showed to indicate an unexpected effect of PCAs to produce biomass under flooding treatment. Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field plant-assisted bioremediation experiment.

**TU245**

**Are PCB half-lives obtained in rhizoremediation experiments reliable? Pitfalls in experimental design and suggested guidelines for conducting the experiments**

F. Terzaghi, University of Insubria (Como) / Department of Science and High Technology - University of Como; E. Zanardini, C. Morosini, University of Insubria / DSAT; G. Gaspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; S. Borin, University of Milan / DeFENS; F. Mapelli, University of Milan; L. Vergani, University of Milan / Department of Food, Environmental and Nutritional Sciences; A. Di Guardo, University of Insubria / Department of Science and High Technology

Greenhouse experiments have been performed to test the capacity of the Populus species (clone Monviso) to grow on a PCB historically contaminated soil and to improve soil quality in terms of contaminant transformation and autochthonous microbial community abundance and activity. The experimental set-up consisted of pots filled with the contaminated soil and poplar cuttings, under the following conditions: microbiologically active soil (TMA), previously sterilized soil (TS), microbiologically active soil in hypoxia (TMAA). Moreover, non-planted soil was used as control. PCB concentrations in soil samples and plant roots were analysed 6 months and 12 months after the start of the experiments. At the same time plant growth, biomass production and plant stress indicators (i.e. chlorophyll content, leaf fluorescence, antioxidant in plant tissues) were investigated together with cell abundance, diversity and viability of soil microorganisms under the different growing conditions. The overall results showed the capability of the clone Monviso to transform and bioremediate PCBs in roots. The PCB transformations were initially higher in the microbiologically active soil; subsequently in line with a high microbial growth of the sterilized soil, the amount of indicator congeners found were similar between the two treatments. The anoxic treatment differed in terms of congeners detected, microbial community structure and activity and plant physiology stress indicators. However, the Monviso clone showed to indicate an unexpected effect of PCAs to produce biomass under flooding treatment. Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field plant-assisted bioremediation experiment.

**TU246**

**Effect of Organic and Inorganic Fertilizers on the Bioremediation of Used Motor Oil Polluted Soil**

P. Ferdinand, U.E. Ezejie, Federal University of Technology Owerri / Biotechnology

Three treatments (poultry manure (PM), Nitrogen Phosphorus Potassium fertilizer (NPK), and a combination of both) were used for bioremediation of soil spiked with used motor oil to determine the potential of these treatments in enhancing biodegradation of used motor oil in soil. The degree of biodegradation of the oil was
studied for a period of 4 weeks under laboratory conditions. Hydrocarbon-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0x10^4 and 30x10^4 CFU/g compared to unamended control soil throughout the 4 weeks of study. Oil-contaminated soil amended with a combination of poultry manure and NPk fertilizer showed the highest reduction in total petroleum hydrocarbons with loss of 80% in the 4th week compared to other treatments. The results obtained demonstrated the potential of the treatments for oil bioremediation in the order: Poultry Manure and NPk > Poultry Manure > NPk.

TU247

Soil pollution and physico-chemical properties steer the bacterial community structure in the uneven highly polluted SIN Brescia-Caffaro site.

E. Magelli, University of Milano - DeFENS / Department of Food, Environmental and Nutritional Sciences; L. Vergani, University of Milano / DeFENS; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology; Como; G. Rasp, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Zanardi, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milano / DeFENS

Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity but can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbial selection are therefore pivotal to develop in-situ bioremediation techniques. In this paper, the Spatial Property Site SIN Brescia-Caffaro (Italy) offers a fascinating natural laboratory due to its extremely high, old, mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). Our aim was to study the spatial correlations between environmental factors (pollutant fingerprints and soil physico-chemical properties) and the soil microbial community structure. More than 200 samples of soil sampled in the Caffaro area were analyzed with a three-dimensional geostatistically conceived grid, and were analyzed to estimate the soil hydrolytic activity, the physico-chemical features and the concentration of metals and PCB congeners. A cultivation-independent approach led to unravel the phylogenetic structure of the residing bacterial communities. By means of statistical analyses, we showed that significantly different bacterial communities were selected in the investigated areas within the SIN Brescia-Caffaro. Spatial distribution of bacterial populations within each site was significantly correlated with physico-chemical soil parameters and pollutant concentrations. Soil physico-chemical properties were also significantly correlated to the hydrolytic activity of the soil microbiome, a relevant indicator of soil quality and pollutant availability. The ELS (Emulsified Lecithin Microemulsion) treatment of Chlorinated Solvents in groundwater is a fascinating laboratory due to its extremely high, old, mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). To explore the effects of bioremediation on diversity and functional properties, the ELSMicroemulsion is a food-grade compound that supports the treatment of a wide range of groundwater contaminants, including chlorinated solvents. ELS is the acronym for Emulsified Lecithin Substrate, a technology designed to create reducing conditions and promote enhanced reductive dechlorination (ERD) reactions. In general, organic carbon addition in a saturated zone is well-known to promote conventional enzymatic reductive dechlorination reactions. This happens because carbon in the subsurface will support the growth of indigenous microbes in the groundwater environment. As bacteria feed on the soluble carbon, they reduce the chlorinated compound to the less toxic form, thereby restoring the redox potential in groundwater. As bacteria ferment the ELS, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic and butyric, which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators. Lecithin itself is composed primarily of phospholipids, which have both hydrophilic and hydrophobic regions in their molecular structure. As a result, ELS tends to be stable emulsions, expectedly more stable than with only hydrophobic compounds. Further, phospholipids support remediation by providing essential nutrients (carbon, nitrogen, phosphorus) to bacteria. ELS Reagent was shown to effectively treat tetrachloroethylene (PCE) and its catabolites in the aquifer. The site is a former manufacturing facility in Italy impacted for more than 2,000 m² with PCE from a historical solvent release. The main contaminated area and the down gradient plume showed maximum PCE concentrations up to 5,000 ppb in the swallow aquifer. In 2016, the consultancy firm performed a field scale injection of ELS with a goal to reduce the PCE mass and its catabolites in the source area and the distributed plume and treat any residual...
VOCs potentially migrating from beneath the former facility. A total of 4900 kg of ELS concentrate was emulsified and injected under pressure thought 51 fixed wells in the swallow contaminated aquifer. Subsequent field monitoring showed PCE and TCE below detection limits at all wells after 6 months. A 99.8% reduction of PCE and TCE was observed in the source and plume areas along with the reduction of the recognized contaminants, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloroethane has also been observed in all the monitoring wells.

TU251 Cheese whey effects on microbial communities in contaminated groundwater of an urban area

D. Vleeska, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Regional Hospital in Liberec / Centre of Clinical Biochemistry; S. Wachavek, A. Sevcu, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation

Chlorinated ethenes (CE) are the second most ubiquitous contaminants worldwide. Herein we describe an urban locality Novy Budyov (Czech Republic) where groundwater pollution was identified in private wells in 2007. The source of CE contamination was machinery, metal cutting, and chemical industry, now out of order. The improper handling of hazardous compounds (e.g. chlorinated hydrocarbons, mineral oils etc.) caused uncontrolled contamination of Quaternary aquifer which is about 4-5 meters thick, composed of sandy gravel and delimited by impermeable 400 meters thick Mesozoic strata. Application of different carbon sources (lactate, glucose, cheese whey and polyethylene glycol) on the CE-contaminated groundwater was previously tested in the bench-scale studies and based on these experiments, cheese whey was chosen for the in situ application. The effect of three consecutive cheese whey applications (first was in October 2017) on indigenous microbes was described using qPCR Due to the techniques after sampling time the DNA extraction was performed using a FastDNA Spin Kit for Soil according to manufacturer’s protocol. Extracted DNA was quantified using Qubit 2.0 fluorometer. Isolated samples were tested using qPCR method. An universal marker, 16S rDNA gene (total bacteria marker) was used as a control. Other monitored specific markers were focused on presence of *Dehalococcoides*, *Dehalobacter*, *Sulfurospirillum* and vinyl chloride (VC) reductases vcrA and bvcA. In addition denitrifying bacteria were monitored by nirK marker and sulfate reducing bacteria by dsaA marker. All data are counted in relative values. Higher bacterial abundance was detected based on all tested markers after the first cheese whey application. This application will be repeated two more times. Generally, application was successful and bacterial biomass and specific markers for organohalide respiration increased and prevailed in higher concentrations.

Moreover, higher reductive dechlorination was detected in industry-troughed aquifer in comparison to CE-contaminants. Specific markers are still being monitored in the treated groundwaters and will be discussed together with physico-chemical results.

TU252 The Influence of Nanoscale Zero-valent Iron (nZVI) in Combination with Various Organic Compounds (Modifiers) on Dehalorespiring Microflora

K. Markova, Technical University of Liberec / Institute for Nanomaterials, Advanced Technology and Innovation; D. Vlkova, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; J. Nosek, Technical University of Liberec

Among all the groundwater contaminants chlorinated ethenes (such as trichloroethylene (TCE)) can be transformed by combination of abiotic and biotic methods under anaerobic conditions. Currently, nanoscale zero-valent iron (nZVI) is used for the treatment of chlorinated compounds via its strong reducing property. Biological reductive dechlorination of CE is contributed by dehalorespiration. The influence of nZVI in combination with carbosulfon cellulose (CMC), molasses and detergent (anionic surfactant) on the specific dehalorespiring microflora was tested within this study. Groundwater contaminated with CE (1,2-cis-DCE and TCE) was collected from the chemical factory Spolchemie a.s. Batch tests with iron composite and various concentrations of CMC (0.25, 0.5 and 1 g/l), detergent (5, 10 and 20 g/l) and molasses (5, 10 and 20 g/l) were performed for periods ranging from 60 to 360 days after fill-up with no flushing. Strains isolated were used as a template for a real-time PCR amplification. 16S rDNA gene was used as a total bacterial community marker. Specific genes were used for detection of ongoing reductive dechlorination (vcrA, bvcA, Dre DHC-RT and Dsb) and to monitor denitrifying and sulphate reducing bacteria (nirK and apsA). CMC bacteria protecting effect when nZVI is applied was observed. Positive effect was exhibited in CE-contaminated bacteria amount (16S rDNA), denitrifying (nirK) and sulphate reducing bacteria (apsA). CMC as the substrate for dehalorespiring bacteria was not confirmed. Detergent enhances nZVI subsurface migration parameters. Direct positive effect on bacterial populations only in denitrifying bacteria was observed. Detergent had even inhibiting influence on dehalorespiring bacteria. Molasses as carbon and electron source had positive effect on all studied groups of bacteria. Interestingly, in combination with nZVI molasses enhanced growth of dehalorespiring but not denitrifying and sulphate reducing bacteria. Molasses is suggested to serve as the substrate for fermentation which produces electrons utilised by dehalorespiration. Molasses as the substrate and nZVI with its pH buffering capacity presented the best conditions for dehalorespiring bacteria. The authors acknowledge the assistance provided by the project No. TF02000064 supported by TACR.

TU253 Mechanistic insight into microbial reductive dehalogenation

S. Zhang, EU Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schuurmann, Helmholtz Centre for environmental research - UFZ / Department of Ecological Chemistry

Microbially mediated reductive dehalogenation provides a promising approach to remediate and detoxify halogenated aromatics. Despite extensive respective studies, the mechanistic understanding of the underlying chemical reactions is still limited. Interestingly, *Dehalococcoides mccartyi* strain CBDB1 and *Dehalobacter* strain 14DxCB1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (chemically bound halogen vs. H) by the nucleophile cob(II)alamin (vitamin B12). The latter was unravelled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational molecular orbital (MO) approach has been developed for a more detailed analysis of the molecular initiating event triggering the reductive dehalogenation. Application to 39 aryl halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibenzo-p-dioxins, and brominated benzenes reveals that the lowest symmetry-compatible φ* the substrate located at the carbon-halogen bond mediates the dehalogenation step, and enables discriminating CBDB1 active from non-active substrates for 92%.


TU254 Bacterial biosorption of PFOS from contaminated waters

M. Styliaou, Oerebro University / The Life Science Centre-Biology; I. Ericson Jogsten, Oerebro University / MTM Research centre; P. Olsson, Oerebro University / The Life Science Center-Biology; J. Jass, Oerebro University / SCHOOL OF SCIENCE AND TECHNOLOGY

Per- and polyfluorinated alkyl substances (PFASs) have been extensively used for commercial and industrial purposes since the mid-1960s. Even though they have been classified as bioaccumulative hazardous organic compounds (Stockholm convention 2009). Perfluorooctane sulfonate (PFOS) is highlighted as the most abundant PFAS reported to contaminate the environment, animals and humans. The most frequently applied method for PFOS remediation of water is by passing it through activated granular carbon filters. Currently, there are increasing efforts to find new strategies and cost-effective methods for PFOS remediation of contaminated waters. This study investigated the possibility of removing PFOS by microbial binding. We tested the binding capacity of live and dead *Escherichia coli* OP50 in different PFOS concentrations. The exposed bacterial pellets were subsequently analyzed for PFOS by UPLC-MS/MS. The dead bacteria were found to have high adsorption (286-3324 g/g of bacterial pellet) whereas the live bacteria exhibited lower adsorption (140-254 g/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOS isomers as the live compound which defines the applicability of PFOS bioremediation with dead bacteria as a promising alternative approach. We propose that microbial binding of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination.

TU255 Hexavalent chromium reduction in a bioelectrochemical microbial electrolysis cell

G. Beretta, Politecnico di Milano / Civil and Environmental Engineering; A. Mastorigio, E. Sezenna, S. Sabrina, Politecnico di Milano

Groundwater is the environmental matrix most frequently affected by anthropogenic hexavalent chromium contamination. Due to its cancerogenicity, Cr(VI) has to be removed, hopefully using environmental-friendly and economically sustainable remediation technologies. To overcome the limits of the currently applied bioremediation technologies, an alternative strategy is the use of BioElectrochemical Systems (BESs) to stimulate bioreduction of Cr(VI). BESs include a set of technologies based on biological reactors where an electrode (anode) can function as the final electron acceptor for the oxidation of organic compounds; then electrons flow through the circuit and reach the cathode that acts as the electron donor for the bioreduction of oxidized species. In the present study, we have assessed if Cr(VI) can act as an efficient terminal electron acceptor for an anaerobic biocathode in a Microbial Electrolysis Cell (MEC). The cathode was first inserted into the cathodic compartment of a dual-chamber Microbial Fuel Cell, and inoculated with autotrophic cultore originate from anaerobic digester sludge. After 30 days of acclimation, the electrode was transferred into the cathodic chamber to work at -300 mV (vs. SHE) as the biocathode in a Cr(VI)-reducing MEC. An
abiotic control and an open circuit (OC) control were also operated in parallel. Hexavalent chromium dissolved concentration was analyzed at the initial, during the experiment and final time by spectrophotometric method, while the dissolved total chromium was analyzed by ICP-MS. During the whole test, the current intensity was monitored. At the end of the experiment, the microbial characterization of the communities enriched on the biocathode and in the cathodic sediment was performed. Desulfuromonadaceae was observed in all the tested conditions. Contaminants removal was linked to current production up to 0.36 mA/cm². Current production was also observed in ABL. Sulfate-reducing hydrocarbons (TPH) in the sediment and species, and current production were monitored over time. Samples of the sediment and of the anodic biofilm were collected to characterize the microbial communities by high-throughput sequencing of the 16S rRNA gene. TPH removal was observed in all the tested conditions. Contaminants removal was linked to current production up to 0.36 mA/cm². Current production was also observed in ABL. Sulfate.

**TU258**

Freshwater sediment enrichment to improve MFCs performance for in situ remediation application: a phylogenetic microbial characterization

C. Armato, University of Torino / Department of Public Health and Pediatrics; D. Ahmed, Istituto Italiano di Tecnologia / Centre for Sustainable Future Technologies (CSFT@Polito); D. Traversi, University of Torino / Department of Public Health and Pediatrics; V. Margaria, M. Quagliu, Istituto Italiano di Tecnologia / Center for Sustainable Future Technologies (CSFT@Polito); T. Schilirò, University of Torino / Department of Public Health and Pediatrics

One of the possible application for Microbial Fuel Cell (MFCs) is the in situ remediation of contaminated sites. MFCs operation links the removal of pollutants from contaminated sites to the production of current by means of the activity of electrochemically active microorganisms (EAMs), able to degrade substrate producing a flow of electrons. EAMs have potential applications in bioremediation production, green chemical synthesis, bioremediation, bio-corrosion mitigation, and biosensor development. The aim of this work was to investigate the effect of two enrichments, a general (Gen) and a ferric citrate (FeC) one, to increase the percentage of EAM in order to improve the MFCs performances. A freshwater sediment (Fw) sample was chosen as inoculum source. The effect of the enrichment procedures was compared in term of both electrochemical performance and biological characterization. The microbial community was subjected to three sequential enrichments and then used as inoculum for the MFCs. Anodic potential and current production were measured in all conditions and at the MFCs level (p<0.05). Enrichment with FeC decreased the enrichment efficiency evaluated both for the pre-enrichment and for the three components of MFCs (planktonic, biofilm and rod). Results showed that the MFC inoculated by Gen enrichment pre-culture had better performance than the FeC one (shorter start-up time, lower anode potential, higher current production and power density). The main source of variability related to the kind of enrichment, both in the pre-culture and in the MFCs. Proteobacteria, Bacteroidetes e Firmicutes resulted as the main Phyla in our samples. Geobacteraceae spp. and Pseudomonas spp. decreased more during the FeC enrichments and their DNA concentration was higher in the Gen-MFCs and FeC-MFCs, respectively. Microbial population enriched with FeC showed a lower Shannon diversity index, both in the pre-culture and at the MFCs level (p<0.05). Enrichment with FeC decrease the relative abundance of EAM and the microbial diversity. Previous studies show the need of a heterogeneous community dominated by EAM to improve the removal of contaminants and to increase the performance of the MFCs. The present work indicates that Gen enrichment promoting the development of a self-balancing community seems to be a preferential approach to be implemented in in situ application.
conditions to simulate both natural attenuation and biostimulated degradation processes. Enrichment factors for $^{13}$C were determined by Compound Specific Isotope Analysis (CSIA). High-throughput sequencing (Illumina) and Ion Torrent analysis and quantitative PCR were performed to gain insights into the structure of the microbial community and to identify functional biomarkers. The investigation of the potential anaerobic degradation pathways is not shown because the obtained data are not yet available. During the degradation of MCB was completely depleted upon addition of nutrients and CSIA results confirmed negligible C isotope fractionation under oxidative conditions. The catalytic toluene gene, encoding for toluene dioxygenase, and Pseudomonas were identified as molecular and taxonomic markers, respectively. Recently, analyses of the identified molecular and taxonomic markers for the aerobic degradation of MCB were also applied to another area contaminated by MCB, and nearby the first site, to establish whether an aerobic approach for site reclamation from MCB would be successful in the extended area.

TU260

Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area

T. Stella, University of Milano-Bicocca / DISAT; I. Pietrini, Politecnico di Milano; F. de Ferra, G. Carpani, Research Center for Non Conventional Energy - ENE; M. Marchesi, Politecnico di Milano; L. Alberti, Politecnico di Milano / Department of Civil and Environmental Engineering; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences

Microorganism are the invisible component of terrestrial bioma, they contribute to site owners. Therefore, a detailed chemical, isotopic and microbiological site characterisation (fingerprinting) is crucial to evaluate, at first, the intrinsic remediation of the contaminated area (natural attenuation) and, then the potential of enhancing specific biodegradation processes (biostimulation). This joint study aimed at gathering information on chemical, isotopic and molecular biology data from a contaminated industrial area to quantify the complex mixtures of contaminants, to provide information about the sources of contamination and to assess the potential of degradation degraders and, thus, to enhance the on-going biodegradation processes. Contaminated groundwater was collected from 19 piezometers in a restricted area of the site. Chemical analyses of chlorinated ethenes, 1,1,2-trichloroethane (1,1,2-TCA), 1,2-dichloroethane (1,2-DCA), benzene, toluene, xylene isomers, ethylbenzene and chlorinated benzenes were performed following the standard protocols. Compound-Specific Carbon Isotope Analysis (C-CSIA) were carried out to define the isotopic signatures of 1,1,2-TCA, 1,2-DCA and chlorinated solvents (PCE, TCE, 1,2-cis-DCE, VC). The structure of the microbial community was determined by Illumina High Throughput Sequencing, whereas its functional profile was assessed by quantitative PCR of key genes encoding for enzymes involved in specific metabolisms. Trichloroethylene and 1,2-dichloroethane (1,2-DCA) were found in most of the water samples at high concentration as well as 1,2-cis-DCE. Illumina sequencing data showed a great bacterial diversity probably due to contamination heterogeneity. However, species belonging to the Burkholderiales order of the Betaproteobacteria and Betaproteobacteria were predominant in 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catabolic genes encoding for reductive dehalogenases (PceA, TceA, VcrA, BvCA) and oxidative enzymes (etnC, etmE) will be accomplished (on-going analysis) as well as isotopic analyses.

TU261

Microbial ecology and ecosystem services: a key role for biotechnological applications


Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations (P)

G. Pantano, T.C. Souza, P.S. Fadini, A.A. Mozeto, Federal University of Sao Carlos

Introduction: Despite the scenario of excess phosphorus in some aquatic environments, there has been an increase in the demand for phosphorus-based fertilizers and wastewater deposits, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorus from eutrophic systems, for further use as fertilizer. The aim of this work was to study the phosphorus adsorption using sawdust as organic adsorbent. Methods: This study was carried out with water and sediment samples from an eutrophic ecosystem, Barra Bonita reservoir, located in Barra Bonita city, Sao Paulo State, Brazil. The microcosm experiments were conducted in 5 L glass jars, that were filled with sediment and water from the reservoir. Among the 36 assembled microcosms, 18 were used as controls and 18 were used as treatment (with bags containing sawdust). The dissolved oxygen, iron, and orthophosphate were determined in interstitial water and water from the jar’s water column. Emerging contaminants and adsorbed phosphorus (P) were determined by standard methods. Results: sawdust was able to adsorb dissolved oxygen values in the control microcosms were significantly higher ($p < 0.05$) in comparison to the treatment microcosms, as a consequence of the organic matter oxidation present inside the bags. The lowest concentration of Fe(II) found in the water column of the control microcosms causes the oxidation of the superficial sediment and this oxidized layer was responsible for the reduction of internal flow of P. In the interstitial water the Fe(II) concentration is much higher than in the water column due to the large amount of Fe present in the sediment. The concentration of orthophosphate in the water column varied during the experiment, in the treatment microcosm the decrease was indicatived of phosphorus adsorption. It was observed that the adsorption of phosphorus on sawdust began after 57 days. The maximum adsorption was at 214 days (41.4 μg P g$^{-1}$ sawdust). The adsorption of triclosan, estrone, 17α-estradiol and 17-β-estradiol were less than the limit of quantification (LOQ). Conclusion: Sawdust is considered a biosorbet, of easy access and low cost, to use in the remediation of eutrophic environments. The possibilty of phosphorus recovery is important to ensure water and global food security. Acknowledgments: FAPESP (2016/00490-6)
Formation potential of trifluoracetate and its estimation by means of the TOP assay

J. Janda, DVGW Water Technology Center / Analysis and Water Quality; K. Nöder, TZW DVGW-Technologiezentrum Wasser / Analysis and Water Quality department; F. Lange, DVGW Water Technology Center / Analysis and Water Quality; C. Zwiener, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tuebingen / Geosciences; H. Brauch, DVGW Water Technology Center / Analysis and Water Quality

Trifluoracetic acid is the perfluorinated carboxylic acid with the shortest-possible chain length and thus a small, persistent molecule. Due to its high acidity (pK< 0.25) it occurs in its anionic form (trifluoracetate, TFA) in the aquatic environment and is considered as highly mobile. Photochemical conversion of volatile refrigerants (e.g. 1,1,1,2-tetrafluoroethane) is the most frequently discussed anthropogenic source of TFA. However, its formation in the environment has also been shown for other substances containing trifluoromethyl moieties. Hence, a large number of active substances in modern crop protection agents, pharmaceuticals or industrial chemicals have to be regarded as potential TFA precursors. In the present study, the TFA formation potential of environmentally relevant substances was determined using the so-called total oxidizable precursor assay (TOP assay). In order to analyze the resulting concentrations of TFA, a method for quantitative extraction of the analyte from the highly alkaline and saline digestion solutions was developed. The subsequent measurement was performed using gas chromatography coupled to tandem mass spectrometric detection (IC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet, fluopicolide, fluopyram, flurtamone and tembotrione; pharmaceuticals: fluoxetine and sitagliptin; industry chemicals: 4:2 FTSAs and 6:2 FTSAs) led to substance-specific molar yields between 7.1% (6:2 FTSAs) and 96% (sitagliptin). It is known from previous studies that TFA can be formed during waste water treatment. Therefore the formation potential of samples from six treatment plants (WWTPs) was investigated. As expected, more TFA was formed after oxidation of the influents (up to 180% increase relative to the concentrations without oxidative treatment) than of the effluents (between insignificant and 140%). Interestingly, one WWTP exhibited a strong (biological) formation of TFA, which could be confirmed quantitatively using the TOP assay.

A Challenge for pesticide regulators: The example of 1,2,4-triazol in groundwater - Overview of regulatory strategies in Germany, Denmark and France

B. Flett, BVL / Department for plant protection products; W. Tütting, BVL; A. Gimsing, The Danish Environmental Protection Agency / Pesticides and Genotechnology; A. Boivin, ANSES; A. Gathmann, BVL / Department for plant protection products

The substance 1,2,4-triazol is a known metabolite of several fungicidal active substances used in plant protection products. Modelled groundwater concentrations of potential uses of each active substance are below the limit value of 0.1 µg/L. In plant protection regulation, this limit value has to be applied for 1,2,4-triazol due its toxicological relevance according to the regulation (EC) 1107/2009. Exceedance of this trigger has been questioned considering that several fungicidal active substances forming 1,2,4-triazol may be applied consecutively. In addition, plant protection products are not the single source of 1,2,4-triazol. It can also originate from the biodegradation of insect inhibition uses as additive to fertilizers, or even be formed naturally in forest soils. Consequently leaching of 1,2,4-triazol from these different sources might lead to exceedance of the limit value for groundwater in agricultural catchments. Therefore, the competent authorities of Germany, Denmark and France have initiated monitoring programs and incidence reporting. If entries above 0.1 µg/L in groundwater are found and entry via pesticide application is considered likely, authorities may have to decide on further risk management actions. Possible mitigation measures are discussed and the difficulties in dealing with different sources and regulatory frameworks are highlighted.

PPPs on the basis of natural compounds: nature challenges analytics

M. Andre, F. Stahl, C. Jansen, SGS Institut Fresenius GmbH

For many plant protection products (PPP) using natural compounds as an active ingredient, considerable background levels are frequently observed in untreated control material. These contaminations originate from both, natural and anthropogenic sources. Applying the method described in this contribution and residue analysis more challenging. There are different routes for natural background concentrations resulting from natural sources as amongst which are: physicochemical degradation from higher compounds (e.g. degradation of triglycerides to fatty acids), microbiological activity or the use of a plant product as active ingredients (e.g. rapeseed oil). Besides the natural occurrence of the active ingredient or parts of it, anthropogenic routes of contaminations are also diverse: some active ingredients of PPPs were used in industrial production processes (e.g. short-chained fatty acids as softener for plastic materials), other compounds are incorporated in materials used for solvent production. Both may lead to high background levels. Both routes, the anthropogenic as well as the natural, can lead to background level contaminations of the active ingredients, making it hard or in some cases impossible to find contaminant-free control material and/or to determine these active ingredients at low concentration levels. Furthermore, natural compounds used as active ingredients in PPPs or their derivatives are of low molecular weight and thus leading to fragments < 100 Da in LC-MS/MS analysis. These are more difficult to analyse as the signals of these mass transitions are often disturbed.
Furthermore, the results were used within the scope of a Compartment data including biodegradation kinetics for compounds on the screening the WSST and the SST are suitable to determine sound and reliable biodegradation kinetics. The test systems MITI, WSST and SST were included, the experiment results indicate that the biotic processes could be divergent between rivers, but also between sediments taken up- and downstream the WWTP. An analysis of the microbial diversity in sediment and water of each river will complement the differences in dissipation rates observed for the treatments.

TU269

OECD 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers

C. Coll Moro, Stockholm University / Environmental Sciences and Analytical Chemistry; Z. Li, Stockholm University / ACES; R. Bier, S. Langenheder, Uppsala University / Department of Ecology and Genetics/Limnology, A. Sohek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES Persistent pharmaceuticals in aquatic ecosystems are of particular societal concern and the OECD 308 guideline is often used to obtain the biodegradation half-lives required for risk assessment. The environmental relevance of OECD 308 has been criticized in recent years by showing the difficulty to interpret multiphasic processes (biotic and abiotic) and the lack of compartment-specific half-lives for water or sediment as an outcome. In particular, biodegradation processes in the sediment can vary according to the microbial communities, which may be impacted by the selection pressures for the test i.e. sediment-water ratio, aerobic-anoxic conditions and initial concentration levels. In this study, we have investigated the differences in biodegradation of a mixture of 9 pharmaceuticals (acetaminophen, caffeine, carbamazepine, diclofenac, fluconazole, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Fyris and Grindlach, before and after the discharge of a wastewater treatment plant (WWTP). Bottle incubations were set following the OECD 308 guideline, spiked with pharmaceuticals and incubated for 40 days at 16°C in the dark with daily aeration. Water samples were taken at 10 time points and analyzed in UHPLC-MS/MS. The microbial community composition in the sediment was analyzed with Illumina sequencing of bacterial 16S rRNA to provide more insight into the biodegradation potential in the different treatments. The dissipation half-lives obtained for diclofenac, oxazepam, tramadol, and venlafaxine are significantly different (p < 0.01) between rivers and between locations. Additionally, the half-lives of non-sterile treatments are significantly shorter than sterile (p < 0.01) for all compounds except carbamazepine, indicating that dissipation reflects a combination of biodegradation and sorption mechanisms. Furthermore, compound concentrations remained constant in river water treatments, with only caffeine and acetaminophen showing signs of degradation. Dissipation of pharmaceuticals in the sediment compartment was more relevant than the kinetic data. Sorption cannot be completely excluded, the experiment results indicate that the biotic processes could be divergent between rivers, but also between sediments taken up- and downstream the WWTP. An analysis of the microbial diversity in sediment and water of each river will complement the differences in dissipation rates observed for the treatments.

TU270

Compartment-Specific Screening Tools - Development and Application to Assess Potential Persistence of Organic Compounds in Water, Sediment and Soil

T. Junker, ECT Oekotoxikologie GmbH; A. Coors, ECT Oekotoxikologie GmbH; G. Schürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry The persistence assessment under REACH ideally relies on compartment-specific degradation half-lives that are generally derived from aerobic laboratory simulation studies for surface, aquatic sediments or soil. Albeit these data are given top priority, they are not available for most of the compounds since simulation tests are time-consuming and expensive, and they are required only for compounds with a production volume of 100 or more tons per year. Thus, screening information (e.g. results from ready biodegradability tests (RBTs) or quantitative structure-activity relationship (QSAR) models) are used in the absence of simulation test data to decide whether a substance is considered as “not persistent” or potentially persistent according to screening criteria. However, RBTs only assess the water compartment, whilst QSAR models are usually developed based on qualitative experimental biodegradation data related to water-only test systems. Therefore, half-lives for soil and sediment are calculated by multiplying the half-life in water by constant factors. However, this extrapolation is questionable due to different conditions in the compartments, which might affect biodegradation in connection with the physico-chemical properties of the compounds. Consequently, there is a lack of experimental quantitative biodegradation data for soil and sediment at the screening test level. In the present work compartment-specific screening tools for water-sediment (Water-Sediment Screening Tool, WSST) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WSST and SST were applied to determine degradation data for a set of fifteen test compounds. The results demonstrate that the WSST and the SST are suitable to determine sound and reliable biodegradation data including biodegradation kinetics for compounds on the screening test level. Furthermore, the results were used within the scope of a Compartment-Specific Persistence Screening (CSPS). The results of the CSPS were in good agreement with the REACH standard persistence screening, resulting in slightly more conservative but reasonable results. Thus, the data can be applied to identify potentially persistent compounds in the regulatory context. Beyond that, the results can be used as input parameters for multimedia fate models to assess the environmental fate of the compound, e.g. overall persistence (P∞).

TU271

Persistency assessment of pesticides in Denmark

A. Gimsing, The Danish Environmental Protection Agency / Pesticides and Gentechnology; A. Aagaard, S. Marcher, The Danish Environmental Protection Agency / Pesticides and Biocides; V. Mikkelsen, The Danish Environmental Protection Agency Persistent active substances can affect the environment over long periods of time, as such substances can be distributed and accumulated within and outside the areas where they are used. Persistent substances constitute a long-term and difficult-to-quantify risk of spreading in the environment and affect organisms. Persistent substances can also cause effects on and lead to residues in subsequent crops. This also applies to the metabolites of an active substance. Therefore active substances with a DT50 above 180 days cannot be approved in Denmark. The persistency evaluation is based on an assessment of available reliable half-lives from both laboratory and field studies. All half-lives should be normalised to 20 °C and pH2. Assessment of persistency should not be based on average or percentiles of the data. Instead data are assessed by considering the soil types used and focusing on soil types representative for Danish conditions. If in general these soils have a DT50 above 180 days, products with such active substances cannot be authorized for outdoor uses in Denmark. If only some of the soil DT50 values are above 180 days, an ad hoc assessment is performed to decide if these findings constitute the major part of data and if it is likely that DT50 for Danish soils is above 180 days under field conditions relevant to the intended use. The persistency evaluation should be performed for both the active substance and metabolites. However, metabolites which fulfill certain criteria are considered to be of no concern regarding persistency.

TU272

Influence of Winter Conditions on Fungicide Persistence in North American Golf Course Turfgrass

P. Koch, University of Wisconsin - Madison / Molecular and Environmental Toxicology Center Fungicides are routinely applied to golf course turfgrass prior to winter to protect plants from psychrophilic plant pathogens. The persistence of these fungicides is of crucial importance to the various environmental conditions present during winter is poorly understood despite important implications for human and environmental health as well as disease control on the turf. A 3-year field study was initiated at the University of Wisconsin - Madison (Wisconsin, USA) in 2015 to determine which environmental conditions most influenced the persistence of the fungicides propiconazole and chlorothalonil. Fungicides were applied on 20 Nov 2015 and again on 5 Dec 2015 and 10 cm diameter turfgrass cores were collected biweekly from the experimental area during each winter. Both winters experienced above-average temperatures in December with frequent rainfall events, and the concentrations of both fungicides in the turfgrass leaf tissue fell dramatically within the first 28 days after application. In addition, a corresponding increase in M. nivale-disease symptoms in the controlled environment chamber was observed as fungicide concentration decreased. These results suggest that fungicides do not persist in winter conditions following rainfall events, though it remains unclear whether they persist for prolonged periods of time on frozen turf and under prolonged snow cover.

TU273

Biodegradability of novel graft copolymer with levan and polystyrene

B. Lončarević, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department of Chemistry; M. Ljiljanac, Institute of Chemistry, Technology and Metallurgy, University of Belgrade; G. Gojgić, ECT Oekotoxikologie GmbH; A. Coors, ECT Oekotoxikologie GmbH; M. G. V. Balachandran, Intrinsik A/S The biodegradability of novel graft copolymers, which fulfill certain criteria are considered to be of no concern regarding persistency.

Biodegradability of novel graft copolymer with levan and polystyrene

B. Lončarević, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department of Chemistry; M. Ljiljanac, Institute of Chemistry, Technology and Metallurgy, University of Belgrade; G. Gojgić, ECT Oekotoxikologie GmbH; A. Coors, ECT Oekotoxikologie GmbH; M. G. V. Balachandran, Intrinsik A/S The biodegradability of novel graft copolymers with levan and polystyrene is of particular societal concern. The results of the CSPS were in good agreement with the REACH standard persistence screening, resulting in slightly more conservative but reasonable results. Thus, the data can be applied to identify potentially persistent compounds in the regulatory context. Beyond that, the results can be used as input parameters for multimedia fate models to assess the environmental fate of the compound, e.g. overall persistence (P∞).

Persistence Screening (CSPS). The results of the CSPS were in good agreement with the REACH standard persistence screening, resulting in slightly more conservative but reasonable results. Thus, the data can be applied to identify potentially persistent compounds in the regulatory context. Beyond that, the results can be used as input parameters for multimedia fate models to assess the environmental fate of the compound, e.g. overall persistence (P∞).
Levan was isolated after fermentation of *Bacillus licheniformis* strain. Syntheses of copolymer were performed by the free radical reaction using potassium persulfate as initiator. Verification of the synthesis was recorded by 13C NMR Bruker AVANCE III 500 spectrometer. Biodegradation potential in aerobic conditions of obtained copolymer was investigated using Micro-Oxymax respirometer (Columbus Instruments, Ohio). O2 consumption of samples mixed with soil was measured in period of 28 days. The 13C NMR spectrum of copolymer showed the presence of monomers contained in both copolymers. The O2 content in copolymer sample (705.0 L) compared to control (350.9 L) and polyly stere (499.5 L) after 673 h. The formation of levan and polyly stere graft copolymer was confirmed by 13C NMR analysis. Results after 28 days in aerobic biodegradation in soil shows that obtained novel copolymer has biodegradation potential, however additional tests for biodegradation are needed.

**TU274**

**Aerobic degradation of styrenated phenol in soil: influence of the temperature and of the characteristics of the soils**

M. Enrico, SOLVAY / HSE - PRA PS; P. Chagnon, SOLVAY / Research and Innovation

The persistence of chemicals is assessed through their kinetic of degradation in the environment. Several simulation tests are available to evaluate the half-life of the chemicals in different environmental compartments. The half-life is then compared to the Annex XIII criteria of REACH to decide if the substance is be considered as Persistent (P) or very Persistent (vP). Nevertheless, the interpretation of those tests is complex. Degradation rates of 2,4, 2,6- and 2,4,6-TDA were studied in different soils under different conditions of the methods. In the present project, the rate and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

**TU275**

**Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests**

C.R. Boesi, BASF SE / FEP/PA; C. Gaertner, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; H. Schwarz, BASF SE / RB/T; R.J. West, International Isocyanates Institute, Inc. / Toxicology and Environmental Research Consulting

The OECD ready biodegradability tests (RBT) are designed to approximate the rate/extent to which substances are degraded in the environment, such as is more precisely measured in the OECD simulation tests. This work compares results obtained from both test types for degradation of the toluenediame (TDA) substances. Degradation profiles were measured in the sediment tests. Samples were analyzed using liquid chromatography-tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray tandem mass spectrometry (UHPLC-HRMS/MS) for qualification. Two major biotransformation products were detected in the study based on phase I & II biotransformation mechanisms. Diphenyl phosphate (DPPH), product of phase I reaction, was identified for biotransformation products both biota and medium. Among phase II reaction, sultonyl triphenyl phosphate was verified; intermediate metabolites were not significantly detected due to short retention times. Parent compound (TPHP) and hydrolysis products (DPPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DPHP; as TPHP showed decreased, degradation product (DPHP) ratios increased. In conclusion, hydrolysis and sulfation were major mechanisms for biotransformation products of TPHP in environment. As a result, the risk to aqueous organisms must be estimated in order to develop regulations for organophosphate flame retardants in aquatic system.

**TU276**

**Evidence for Anaerobic Microbiodegradation of PCBs and PDBEs in Sediment cores from an e-Waste Site, South China**

B. Mai, Guangzhou Institute of Geochemistry; C. Huang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences; Y. Zeng, Guangzhou Institute of Geochemistry

Biodegradation of polychlorinated biphenyls (PCBs) and polychlorinated diphenyl ethers (PDBEs) is an important transformation and detoxification route in the environment. To better understand the in-situ microbial degradation of PCB and PDBE in anaerobic sediment, three sediment cores from an e-waste dismantling site, Shenzhen China, were sampled (named #1, #2, and #3, respectively). Positive factorization model (PMF), compound specific isotope analysis (CSIA), and microorganism analysis were used to trace the in-situ biodegradation of these pollutants. High levels of PCB (44-67800ng/g, dw) and PDBE (62-792000ng/g, dw) were found in all the samples and the concentrations were generally increased from bottom to the top layers. PMF analysis indicated that the technical mixtures are the dominant PCB and PDBE input and dehalogenation takes place in the sediment cores, especially for PDBEs. This conclusion was supported by the microorganism analysis, substantial Dehalococcoidetes were found in the sediment cores. The range of the relative abundance of Dehalococcoidetes for three sediment cores (#1, #2, #3) was 1.50-9.01%, 1.47-5.24%, and 0.20-2.55%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation source) /∑PDBEs (with the values of 0.02, 0.05 and 0.01, respectively). As for CSIA analysis, only the stable carbon ratios (δ13C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20cm of the #3 sediment cores were obtained. An increase in the δ13C values for BDE 28 and a slightly decrease in the δ13C values for BDE 85 were found with the increase of the depth sediment cores, indicating a potential biotransformation of these compounds in the cores. No significant differences in the δ13C values of BDE 47 and BDE 99 were observed in the sediment cores, possibly due to the complicated fate of these compounds, such as BDE47 and BDE99 being both reactants and products during the decompensation processes.

**TU277**

**Transformation and degradation mechanisms of flame retardant triphenyl phosphite in aquatic environment**

Y. Choi, Guangju Institute of Science and Technology; S. Kim, Guangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Organophosphate flame retardants (OPFRs) in aquatic environment are concerned because they are latest alternative chemicals of brominated flame retardants. Among OPFRs, triphenyl phosphate (TPHP) shows high consumption volumes, as well as high concentration in water. TPHP caused toxic effects especially in aquatic organisms but research of biotransformation products is insufficient. Kinetic studies of TPHP and transformation products are important to understand the effects on environmental organisms. To identify the biotransformation products of TPHP, *Daphnia magna* was used due to its sensitivity to aquatic environment. TPHP was exposed to individual *daphnia magna* and each samples were separated by biota and remaining medium. *Daphnia magna* were homogenized and remaining medium were extracted with solid phase extraction. Samples were analyzed using liquid chromatography-tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray tandem mass spectrometry (UHPLC-HRMS/MS) for qualification. Two major biotransformation products were detected in the study based on phase I & II biotransformation mechanisms. Diphenyl phosphate (DPPH), product of phase I reaction, was identified for biotransformation products both biota and medium. Among phase II reaction, sultonyl triphenyl phosphate was verified; intermediate metabolites were not significantly detected due to short retention times. Parent compound (TPHP) and hydrolysis products (DPPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DPHP; as TPHP showed decreased, degradation product (DPHP) ratios increased. In conclusion, hydrolysis and sulfation were major mechanisms for biotransformation products of TPHP in environment. As a result, the risk to aqueous organisms must be estimated in order to develop regulations for organophosphate flame retardants in aquatic system.
photolytic and biological degradation of these substances in aqueous solutions. Each compound was irradiated with artificial sunlight (xenon lamp, 300–800 nm, SUN-test CPS+). During the irradiation time of 8 hours, samples were taken every two hours and analysed directly with HPLC–UV/VIS. An adapted closed bottle test (OECD 301 D) was used to investigate ready biodegradability. The degradation rate was determined by measuring the depletion of diluted oxygen during a period of 28 days. This was achieved by means of a photometric determination of dissolved oxygen in a temperature-controlled water bath. After 6 hours, 99% of the substance \( \text{P}_2\text{MeNC}_2\text{H}_3\text{SiMe}_3 \) was primarily eliminated. During the test, generation of more polar transformation products was observed. The other substances were eliminated between 15 and 65% with treatment of sunlight during a time period of 8 hours. No ready biodegradability could be observed for these five substances. The results from the biodegradation test on the tested substances compare well to our own database on siloxanes. Increased water solubility of the newly synthesised silicon organic compounds did not result in an increased biodegradability in water.

**TU279**

**Biodegradation of adsorbed oil pollutants: Research on a model system**

L. Milic, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; M. Ilic, IChTM / Department of Chemistry; B. Loncarevic, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department for Chemistry; T. Soletic Knudsen, IChTM / Department of Chemistry; J. Avdalovic, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; H. Mirkovic, Faculty of Chemistry; M. Ilic, IChTM / Department of Chemistry; B. Loncic, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; M. Sallon, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry.

Environmental pollution by various types of oil has been, and continues to be, a specific and serious problem. Investigations and development of new techniques are required, as well as improvements to known ones. Sorbent materials are attractive because they collect the oil and separate it from the oil spill site by absorption. The addition of sorbents to oil spill areas facilitates a change from liquid to semi-solid phase and once this change is achieved, the removal of the oil by removal of the absorbent structure then becomes easier. At this stage, pollutants are separated and concentrated, unlike the environmental conditions where pollutants could spread to very low concentration when it is challenging for apply bioremediation techniques. In this study we tested adsorption and degradation of crude oil, diesel oil and naphtha as model substrates. Two types of natural sorbents were used: organozelite and bentonite. Petroleum pollutants sorption was investigated in the batch tank. Sorption was conducted with sorbents (1g/100 mL), with oil contamination ranging from 80 to 1600 μL and 5834.53 μL of O2 within 115 hours, respectively. The production of CO2 by cells in BED model was more than twofold higher than the O2Q model. As well, BED model obtained highest TPH decomposition at the end of experiments. This results indicate that bioremediation process can be successfully used on adsorbed pollutants, where added value is recycling of sorbent material, but further investigation are required to determine the best conditions for such pollutant pollutants from environment. **Acknowledgements** This work was supported by Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No: III 43004.

**TU280**

**Applying high-resolution mass spectrometry to evaluate chemical persistence in un-spiked natural waters**

Z. Li, Stockholm University / ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES)

Microbial degradation (biodegradation) is an important mechanism for removal of organic pollutants from natural systems. The biodegradability of chemicals is a fundamental determinant of the environmental fate of the compound. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most fundamental determinants of the environmental fate of the compound. The OECD 309 protocol, lasting for a period of 60 days at 20 °C in the dark, was used to determine whether the test substance is biodegradable.

**TU281**

**A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals**

M. Cregut, Frilet, University of Nantes / GEPEA CNRS UMR CBC Laboratory; C. Sweetlove, IOREAL SA / Research and Innovation; J. Chenelbe, LOréal Research / Research and Innovation; J. Lharidon, LOréal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology

According to the United Nations (UN), a substance is the “chemical elements and their compounds in the natural state or obtained by any production process.” This definition has evolved according to different acts of regulation. Another category of substances is UVCB: Unknown or Variable composition, Complex reaction products or Biological materials” such as crude oils or vegetal extracts. In addition, there are “mixtures or solutions composed of two or more substances in which they do not react”. The assessment of complex mixture biodegradability can be limited by technical issues and/or difficulties in defining inherent biodegradability. This work is composed of three different studies to introduce and improve the concept of ultimately transformed organic carbon (UTOC) as a quantification tool for biodegradation. The UTOC approach has been reinforced with ecotoxicological tests using a weight of evidence approach for a moderate % of biodegradation. Finally, the methodology was assessed and validated by an investigation of the biodegradability and ecotoxicology assessment of a complex mixture of unknown unknown composition. Based on the principle of reducing the probability of persistent parent products or generation of toxic by-products during biodegradation, the UTOC approach was shown to provide a robust safety assessment approach, and further research should focus on more complex substances (viscous or solid, absorbable, volatile). The advantages of UTOC are clear; it appears as an appropriate method to quantify the initial raw material converted to an inert product by the action of microorganisms to determine the ready biodegradability of an unknown substance such as a vegetal extract.

**TU282**

**Development of a multi-sensors device to assess the biodegradation of chemicals**

M. Cregut, University of Nantes / GEPEA CNRS UMR CBC Laboratory; V. le Cunff, L. Cathienot, E. Calzolai, Y. Pichot, TRONICO; C. Sweetlove, IOREAL SA / Research and Innovation; E. Grangé, S. Jouanneau, University of Nantes / GEPEA CNRS UMR CBC Laboratory; M. Durand, University of Nantes / UMR CNRS GEPEA CEBAB Laboratory; J. Chenelbe, LOréal Research / Research and Innovation; A. Lahmar, University of Nantes / GEPEA CNRS UMR CBC laboratory; C. Sweetlove, IOREAL SA / Research and Innovation; T. Gerald, University of Nantes / Microbiology

Most of the methods used to evaluate biodegradation have been developed for almost 50 years. According to the fact that annually, hundreds of new chemicals require a biodegradability assessment; the development of new metrological solutions needs to be investigated. Indeed, few measurement systems, enabling an automated assessment for substances of unknown composition, are available. The UTOC concept has been shown to provide a robust safety assessment approach, and further research should focus on more complex substances (viscous or solid, absorbable, volatile). The advantages of UTOC are clear; it appears as an appropriate method to quantify the initial raw material converted to an inert product by the action of microorganisms to determine the ready biodegradability of an unknown substance such as a vegetal extract.
modeling steps involving the use of different parameters such as O_2, CO_2, pH, T°C, Pressure and Biomass. These technological investigations will be used to create an unique automated device enabling the evaluation of biodegradation of a chemical whatever its physicochemical characteristics.

TI/263 Investigations on key parameters of an innovative biodegradation test based on cell proliferation

S. Rey, Firmenich / Biotechnology; B. Ozél Duygan, University of Lausanne / Fundamental microbiology; S. Leocata, L. Baroux, P. Merle, Firmenich; J. van der Meer, University of Lausanne / Department of Fundamental Microbiology; M. Seyfried, Firmenich

Several OCD screening tests for biodegradation are useful tools for determining the potential of chemicals to undergo decomposition and mineralization in the environment. Most of these are carried out at high test compound concentration and are based on simple readouts such as CO_2 formation or oxygen consumption, and usually neglect biomass formation. Our research attempts to fill a gap in the knowledge on bacterial physiology in tests conducted as a result of increasingly relevant concentrations of industrial chemicals compared to existing OECD 301 series tests. Recently the feasibility of performing cell counting by flow cytometry was demonstrated for mixed cultures from WWTP sludge and lake water. The present poster reports on key parameters of this new biodegradation test method, notably effects of initial cell and test compound concentration and test duration on the test outcome, as well as on yield determination and on data analysis of flow cytometry cell counting. As test compounds, selected reference chemicals were chosen from the ECETOC MCC/007 report list suggested for method development for readily and non-biodegradable compounds. Alongside cell counting, several test compounds were analyzed in parallel for CO_2 and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

TI/284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances

T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tomoyama, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Morita, Kao Corporation / Safety Science Research

Ready biodegradation studies (OECD TG 301) are required for registrations and the development of chemicals for various applications. Current test systems work well for many substances, but some substances, called “difficult substances” sometimes face problems with these test systems. Here challenges and solutions in ready biodegradation studies are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylhentriacontane, is insoluble in water and tends to stay on the water surface. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the microorganisms could not access the test substance well on the surface water. To overcome this challenge, the test substance was wrapped in a nylon sheet so that it could stay in the water for access by the microorganisms. With this test system, the biodegradability was remarkably improved and it was regarded as ready biodegradable. This method and result were accepted by the Japanese authority. An aroma chemical, 3,5,5-trimethylhexanonic acid, is insoluble in water and tends to stay on the water surface and volatilize. An initialready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the test substance disappeared from the test system by volatilization. To elucidate this hypothesis, the concentration of the test substance and a possible hydrolyzed metabolite were monitored by chemical analysis in the water phase. The result indicated that the test substance volatilized within 48 hours. This result strongly suggested that the low biodegradation result was due to the rapid volatilization and disappearance of the test substance from the test system. The possible solutions to this challenge will be discussed in the presentation.

TI/285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants

B.A. Poursat, University of Amsterdam/IBED Institute / Institute for biodiversity and ecosystem dynamics; J. Dalmijn, University of Amsterdam / IBED; M. Braster, VU University Amsterdam; R. Helmus, University of Amsterdam / IBED; R.J. van Spanning, VU University Amsterdam; P. de Voogt, University of Amsterdam / IBED; P. van Parson, University of Amsterdam / IBED

Assessment of microbial biodegradation is a key parameter for estimating the environmental risk of new organic chemicals. Commonly used tests for the assessment of ready biodegradability (RBTs) have been designed as simple and inexpensive methods to identify chemicals that are not expected to be environmentally persistent in most of the ecosystems. However, RBTs suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. These tests are low throughput, space consuming and poorly reproducible. Moreover, the origin of the inoculum is also a cause of variability in RBTs results. Pre-exposure of the inoculum to the tested chemical prior to any test has been proposed as a method to improve biodegradability testing. Pre-exposure could allow a better persistence prediction of chemicals present at low levels in wastewater or of newly produced chemicals by including the natural adaptation ability of microbial communities. Therefore, in order to assess the influence of the inoculum origin and of pre-exposure on RBTs, we compare the biodegradation capacity of activated sludge from different Dutch wastewater treatment plants before and after pre-exposure to five different chemicals. Carbazepine, diclofenac and metformin are commonly detected pharmaceuticals in wastewater, while 4-chloroaniline and N-methylpiperazine are industrial chemicals with erratic behaviour in RBTs. In this research, an effort is made to miniaturize the standard OECD 310 procedure. As this test requires large volume vessels, it is difficult to perform large scale tests with multiple inocula and conditions using this glassware. We used sealed 96 well plates, only small amounts used for the incubation and elimination is measured by following the CO_2 production (OECD 310) and the compound concentration by LC-MS/MS. The results of these experiments are expected to show differences between responses of inocula that are not pre-exposed. After pre-exposure we expect to reduce the risks of errors of test results and to enhance biodegradation. Different responses between the different inocula will give valuable information about the future environmental fate of the tested compound. Finally, this knowledge will develop more accurate ready biodegradation testing and lead to a more comprehensive environmental risk assessment of persistent chemicals.

TI/286 Investigations on the role of adaptation in OECD biodegradation screening tests

F. Miffon, C. Dick, Firmenich; K. van Ginkel, AkzoNobel; M. Seyfried, Firmenich

Until recently, adaptation was recognized by the European Chemicals Agency as one of the options in so-called enhanced ready biodegradation tests (RBTs) to provide proof of non-persistence of a test chemical. Since June 2017 (time of publication of the latest version of the Safety Assessment Chapter R.7b: Endpoint specific guidance), adaptation has been explicitly excluded. This decision was presumably based on the concern of a perceived lack of capacity for adaptation in the natural environment but failed to provide scientific justification to generally put into question the environmental representativeness of lab results obtained from lower tier tests. As shown previously, positive results from enhanced RBTs are useful in persistence assessments and help avoid false negatives, usually resulting from the stringency of this type of tests. Based on previous results obtained from enhanced RBTs conducted after adaptation, we selected a structural family of compounds for which solid and reproducible effects were seen after adaptation with different inocula. One of these compounds suggested that adaptation provides valuable information about the enhanced potential of test systems. The outcome of this study will form the basis for further investigations on the environmental representativeness of positive results obtained from enhanced RBTs with adapted inocula.

TI/287 Use of Chemical Analysis to Enhance Biodegradation Tests: A Case Study with Two Gas-to-Liquid (GtL) Products

J. Dawick, G. Whale, C. Hughes, Shell Health / Risk Science Team

The Oslo Paris (OSPAR) Commission, which oversees the OSPAR Convention, currently implements the harmonised mandatory control system (HMCS) for use and reduction of discharges of chemicals in the extraction and production of oil and gas offshore in the North Atlantic. Chemical suppliers must submit a Harmonised Offshore Chemical Notification Format (HOCNF) to the implementing OSPAR member state authority to certificate use of their products offshore. Marine biodegradability screening tests (BST’s) are an intrinsic part of offshore chemical control schemes and the HOCNF registration process. However, the lack of robustness of the marine biodegradation methods has been highlighted in a series of ECETOC workshops, particularly when these are used to assess complex, volatile and poorly water-soluble substances (e.g. petroleum products). We have found that the inclusion of abiotic controls and chemical analysis for total petroleum hydrocarbons (TPH) in freshwater BST’s demonstrates that disappearance of test substances from the test system is often far greater than is suggested by traditional biodegradation tests. In addition, we present results from two marine BST tests (OECD 306 and BODIS) conducted on two synthetic hydrocarbon Gas-to-Liquid (GtL) products. In addition to measuring ultimate biodegradation (by oxygen uptake) in these tests, additional analytical techniques have been incorporated to enhance the interpretation of results. Extraction and analysis of test samples using gas chromatography has been conducted to: i) confirm substance dosing and ii) understand the extent of abiotic losses in the test system. In addition, two-dimensional gas chromatography (GCxGC) was employed to characterise hydrocarbons present in test samples, which were compared back to the composition of the original test substances. An overview of the results and our recommendations on how marine biodegradation tests can be improved and interpreted will be provided.

REFERENCES

biodegradability of various hydrocarbon solvents. SETAC Europe annual meeting 2015, Barcelona, Spain.

TU288 Organising an international ring test to improve the marine biodegradation screening test
A. Ott, T. Martin, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering
A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, biodegradation screening tests (BSTs) form the first tier of assessment, offering relatively simple and cheap characterisations of biodegradability. Most parameters in these BSTs are highly prescribed and conservative, but the microbial inoculum is the least controlled parameter. The resulting high levels of variation have been recognised as a limitation since the introduction of these tests up to today and are especially reported for the marine BST OECD 306. BSTs were designed over two decades ago and are not, in their current form, effective as screens for persistence. In recent years, regulatory emphasis has shifted from identifying chemicals that are rapidly biodegradable to identifying chemicals that are potentially persistent in the environment. Technical guidance documents, which have been prepared under the European chemicals regulation system known as REACH, have suggested several improvements to effectively assess persistence with BSTs. Within their nature, there have resulted in major enhancements also addressing a number of the commonly discussed reasons for high variability and poor reliability of BSTs. The Cefic LRI ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardised set led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these inter-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.

TU289 Tissue-specific accumulation of triphenyltin compounds in marine fishes in southern tropical Hong Kong
R.C. Sham, K.K. Ho, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science
The extensive use of organotin (OT) compounds in antifouling paints and other industrial uses (e.g. as fungicides, wood preservatives, and antibacterial textiles) have resulted in major enhancements of these compounds in urbanized coastal marine environments. Even though the International Maritime Organization (IMO) of the United Nations enacted a global prohibition on the usage of organotin-based antifouling agents on hulls of sea-going vessels in September 2008, Hong Kong had not adopted any regulatory legislation to restrict the production, usage and release of these compounds until early 2017. High concentrations of these compounds, especially triphenyltin (TPT), are still being detected in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these inter-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented. Nonetheless, a comprehensive tissue-specific accumulation profile of TPT compounds in marine fishes is still lacking, and such information will help reveal their toxicokinetics and identify targeted organs of accumulating these compounds.

TU290 POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
s. katabam, IIT Hyderabad; A. Qureshi, IIT Hyderabad / Civil Engineering; P. Chakraborty, SRM University; A.K. Tiwari, NCAOR / Polar environment
We present preliminary results on the occurrence of Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OCPs) in the terrestrial environment [moss, and water] of Schirmacher Hills, Dronning Maud Land, Antarctica. α-HCH concentrations (4.48 ng/g dry sample) were detected in moss samples, while α-HCH concentrations (31.2 ng/g dw) concentrations were higher than those observed by 5 times or more. Out of the tested 28 polychlorinated biphenyl (PCB) congeners, only 6 PCBs were detected. ΣPCBs in moss (122 ± 115 ng/g dw, n = 5) and water (30 ng/L and 165 ng/L, n = 2) are higher by up to 10 times compared to other studies around the continent. Heavier congeners (hexa through nona) in both moss and water samples containing 90% of PCBs. This suggests that some localized sources of PCBs may still exist in the Schirmacher Hills region. It is possible that the old research stations, or tourism base, in the area may be one of those sources. While the observed congener distribution can be explained using congener distributions in known commercial PCB mixtures (Aroclors, Sovol and Clophen) in some samples, a post-deposition transformation in snow/mire (in glaciers) is required to explain the remaining observations. Box modeling exercise to reproduce congener distribution in our environmental samples suggests that degradation half-lives of PCB congeners in snow should differ by at least 20 times between penta-/hexa-/hepta-(1750 h) and octa-(35000 h) congeners, as against the uniform value of one year (8760 h) suggested previously. Different half-lives could be possible, either if the rate of actual photoreductive-dechlorination process is different for congeners other than α-HCH. The aim of our project is to determine the major physico-chemical and biological properties controlling the degradation of PCBs in Brazilian soils. A set of 4 different soils, prescribed for regulatory testing to encompass the typical range of properties, such as pH, organic matter, clay content and cation exchange capacity (CEC), including an on crop version and a pristine version of these soils, was used in my study. My first experiment focused on the rate of degradation and mobility of triphenyltin thiabendazole in four different Brazilian soils and one temperate soil. Thiabendazole exhibited slow degradation due to it adsorbing onto the soil solid surface, thus being unavailable to microorganisms in the soil pore water. Thiabendazole half-lives (DT50) and distribution coefficients (KOC) were higher in some Brazilian soils compared to the temperate soil due differences in their physico-chemical properties. Further pesticides will be tested to determine which key physicochemical and biological properties are the driving force for a compounds fate in tropical soils.

TU291 Degradation of crop protection products in Brazilian soils
N. Basadin, S. Marshall, Syngenta Product Safety / Product Metabolism and Analytical Science; G. Bending, University of Warwick / School of Life Sciences; I. Bramke, M. Garrod, Syngenta Product Safety / Product Metabolism and Analytical Science; C. Mckillian, Syngenta Crop Protection LLC / Product Metabolism and Analytical Science
Recent CPPs become commercially available they are subjected to rigorous testing according to strict regulatory guidelines, including understanding the fate of these compounds in the soil environment. The global use of CPPs requires an understanding of their behaviour in a range of soils, including those from both temperate and tropical regions. Moreover, results from previous CPPs fate studies have shown fundamental differences in Brazilian soils compared to temperate soils. The aim of my project is to determine the major physicochemical and biological properties controlling the degradation of pesticides in Brazilian soils. A set of 4 different soils, prescribed for regulatory testing to encompass the typical range of properties, such as pH, organic matter, clay content and cation exchange capacity (CEC), including an on crop version and a pristine version of these soils, was used in my study. My first experiment focused on the rate of degradation and mobility of fenugric thiabendazole in four different Brazilian soils and one temperate soil. Thiabendazole exhibited slow degradation due to it adsorbing onto the soil solid surface, thus being unavailable to microorganisms in the soil pore water. Thiabendazole half-lives (DT50) and distribution coefficients (KOC) were higher in some Brazilian soils compared to the temperate soil due differences in their physico-chemical properties. Further pesticides will be tested to determine which key physicochemical and biological properties are the driving force for a compounds fate in tropical soils.

TU292 Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-DAD
C.E. Gracio, V. Bianchi, P.G. Silva, A.C. Montini, E.C. Lima, C.L. da Silva, UFABC / CCNH
Bisphenol A (BPA) is a compound widely used in plastificants such as polycarbonates and resins. Its use has been increasing in the last years and researches point that it may be detected in the environment in great concentrations. Moreover, this substance is classified as a pollutant of emerging concern because of its persistence in the environmental systems and its uncertain damages to both human and animal health. Some studies connect the exposition to this compound with cancer and other diseases. In this work, it was evaluated the ability of the fungus Trametes versicolor (Institute of Botany of São Paulo) in degrading BPA by growing the mycelium in a enriched liquid medium and adding a Sigma grade standard. The degradation rate was determined and analyzed in an Agilent 1220 Series HPLC with DAD detector. 87.78% of removal was the average efficiency of the degradation; slightly smaller than other species that our group has investigated in previous works, such as Trametes villosa. In
In marine mammals, food is the main route of entry for contaminants. Their
potential light PAH concentration in the marine environment, altered by
immigration and emigration processes in the various communities.
Such changes could affect the ability of marine mammals to control
the negative impacts of their exposure to non-essential elements. Here,
we investigated the temporal trends of Hg and Cd in liver and kidneys
(main storage tissues) of 183 individuals of the smallest cetacean species in the North Atlantic: the harbour porpoise (Phocoena phocoena).
Both elements showed a significant increase (p < 0.05) of concentrations between 1999 and 2013. Notably, we highlighted a strong increase of the number of individuals exhibiting extreme
values among the range of measured concentrations. In parallel, we analysed
elemental trace elements in 78 forage species (i.e., jellyfish, crustaceans, cephalopods and cartilaginous and bony fish) to assess their quality for predators. Results showed broad differences of their essential element composition. In particular, selenium is a high concentration because of its long-range transport and different Se exposure among marine mammal species depending on their diet, which means that some of them could be less protected against Hg toxicity. Thus, changes in prey quality could have cumulative effects in cetaceans (increase of toxic elements and deficiency in essential ones) impacting the efficiency of detoxification processes in the future.

Impact of biofilm growth on mercury accumulation in Daphnia magna
s.issa, Norwegian University of Science and Technology; T. M. Ciesielski,
Norwegian University of Science and Technology / Department of Biology; S. Einum, Norwegian University of Science and Technology / Centre for Biodiversity Dynamics CBD; .Mikkelsen, Norwegian University of Science and Technology / Department of Chemistry; V. Jaspers, Norwegian University of Science & Technology / Biology
A largely neglected issue in lab-based toxicity testing of pollutants is the potential for other components in the biotic community to influence the effects of toxicants on focal species. For example, in common tests to assess toxicity, such studies to infer toxicity thresholds of aquatic organisms. Nevertheless, such tests are usually conducted in highly standardized conditions and with a minimum of naturally occurring biofilm. Although this allows for standardization, it may hinder ecological relevance. Biofilm commonly grows in culture medium and serves as additional food for Daphnia. It can aslo accumulate mercury (Hg), a pollutant of high interest because of its long-range transport across the globe and its various toxic properties. As such, biofilm can play a central role in the transfer of Hg to higher trophic levels in freshwater ecosystems. By taking this into account, we can better predict effects of Hg in these ecosystems. Therefore, we conducted an experiment where single Daphnia magna clones were exposed to 20μg/L Cd and 2 μg/L Hg (HgCl2) in the presence and absence of biofilm. Our hypothesis was to test for a significant effect of Hg accumulation in biofilm on Hg accumulation in daphnids. Results showed no significant effect of biofilm on Hg uptake in Daphnia. However, biofilm served as an additional source of selenium (Se) to daphnids, thereby increasing Se/Hg molar ratios in the animals. Thus, biofilm played a central role in the transfer of Se through the freshwater food web and in decreasing the risk from Hg toxicity in Daphnia.

Multiple stressor effects on resource quality for consumers: a case study with photobiotic biofilm exposed to phosphorus and ionic silver
M. Danier, K. Sanchez-Thirion, LIEC; C. Crenier, LIEC Université de Lorraine CNRS UMR ; E. Hage, ECOLAB UMR CNRS UPS INPT; A. González, Universidad de Las Palmas de Gran Canaria; F. Perrière, Université Clermont Auvergne; L. Ten-Hage, ECOLOMB UMR CNRS UPS INPT; V. Felten, LIEC / LIEC CNRS UMR; J. Leflaive, ECOLOMB UMR CNRS UPS INPT
Autotrophic biofilms are fundamental biological compartments of many aquatic ecosystems, representing a resource for many important consumers. To date, most studies have tried to understand the impacts of stressors on microbial communities or on functional processes taking place into the biofilm mat. Far less studies investigated the indirect effects of stressors on upper trophic levels through alterations of the quality of biofilms. We investigated, through a laboratory study, the single and combined effects of phosphorus (P) availability and silver contamination on the elemental (Ca, P, N, P) and biochemical (fatty acid profiles) compositions of a diatom-dominated biofilm. We hypothesized that 1) P would enhance the elemental quality while 2) P and silver, through the replacement of diatoms by more tolerant primary producer species, would reduce the
biochemical quality of biofilms for their consumers. The quality of biofilms for consumers was assessed for a common crustacean species, *Garrumblrus fossarum*, by measuring organisms survival and growth rates. Results mainly showed that species replacement induced by both stressors affected biofilm fatty acid compositions, and that P immobilization permitted to achieve low CP biofilms, whatever the level of silver contamination. Garrumblrus growth and survival were not significantly impacted by the ingestion of silver-contaminated resource. On the contrary, we found a significant positive relationship between the biofilm P-content and the Garrumblrus growth, while biofilm fatty acid contents were unrelated to this parameter. This study underlines the large indirect consequences stressors could play on basal resources quality for consumers, and, in turn, on the whole food web.

**TU299**

Soil pollution induced changes in leaf litter chemical composition and in detritivore physiology and activity.

A. Le Navenant, LIEC Université de Lorraine CNRS; E. Billoor, Université de Lorraine, CNRS UMR 7360; A. Cébron, LIEC CNRS UMR Université de Lorraine; S. Coq, CEFE, CNRS, Montpellier; V. Feiten, LIEC / LIEC CNRS UMR 7360; I. Nabani, CEFE-CNRS, Montpellier; F. Maunoury-Danger, LIEC Université de Lorraine - CNRS

In terrestrial ecosystems contaminated with high metal contents (brownfield), recent studies showed that, surprisingly, leaf litter decomposition process could be maintained despite deep changes in bacteria to fungal abundance ratio and invertebrate detritivore community structures. To disentangle the potential mechanisms leading to this pattern, we monitored litter decomposition process, leaf litter quality metrics, and activity by a priming effect. Our results reported an impact of soil contamination on leaf litter chemical composition, leading in turn to significant impacts on detritivore physiology (priming effect) and detritivore community structure. These changes are consistent with the idea that stressors could increase mineralization and air dryness in the leaf litter. However, pollution mediated changes in leaf litter chemistry had no significant impacts on microbial litter colonization (bacteria/fungi ratio) and litter consumption by detrivore, confirming the high resilience of litter decomposition process to soil metallic contamination.

**TU300**

Decomposition rates and feeding activity of soil fauna in relation with stages of plant colonization in mine soils of a Mediterranean area

A. Pahalver Alcalá, J. Álvarez-Rogel, M. Tercero Gómez, Escuela Técnica Superior de Ingeniería Agronómica. Universidad Politécnica de Cartagena / Consejo Superior de Investigaciones Científicas; J. Tecnomar; M. Gonzalez-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM

Organic matter decomposition (tea bag index) and feeding activity of mesoofauna (Bait Lamina) were studied in an abandoned mine tailing area. Six environments were studied: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of *Pinus halepensis* trees > = 4 m high and shrubs under the canopy (P+MS); 4. Dense patches with several *P. halepensis* trees ( = 5) > = 4 m high and shrubs and herbs under the canopy (DP+MS); B) Outside the mine tailings: 5. Polluted forest with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (PF); 6. Control forest not contaminated with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (CF); 7. Control forest not contaminated with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (PF). Roibos and green tea bags were buried in each environment for 110 days. Tea bags were regularly collected from each environment, to calculate mass remaining, decomposition index and organic carbon and nitrogen of the remaining material. In each plot, two groups of 5 baited sticks were vertically inserted. The number of holes partially and fully emptied after 20 days was recorded to calculate the % of holes fed upon. After 50 days, the percentages of mass remaining in the tea bags were: - DP+MS, P+MS and S green tea = 50-55%; roibos tea = 99%; - PF, CF and P green tea = 80-85%; roibos tea = 99%. These percentages were maintained until the day 110. The lower decomposition in CF and PF can be related with more abundance of resources in forest soils outside of the tailings which could induce to microorganisms to use other sources of nutrients different from tea material. However, in more stressed environments, such as mine soils with a contaminated source of substrate, more easily degradable, mainly the green tea, could stimulate microbial activity by a priming effect. Besides, within the tailings, the decomposition in S (the most unfavorable environment "a priori") could be favored by the high soil temperature (average = 28°C), as a consequence of the lack of vegetation, while in other environments the shading by plants maintained the temperature between = 23 and = 25°C. Feeding activity was (4% of holes fed upon). CF ≈ 2%; P ≈ 3%; S = 31%; P+MS = 21%; AF ≈ 8%, DP+MS ≈ 7%. The high % of holes fed in bare soils (S) could be related to the scarcity of resources in this environment which stimulated the consumption of the bait.

**TU301**

Effects of mineral supplements on lead exposure in free-ranging herbivores

J. Pareja Carrera, IREC-UCLM / IREC-UCLM; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; J. Rodríguez-Estival, University of Castilla-La Mancha / IREC-UCLM; J.E. Smiths, University of Calgary / Ecosystem and Public Health; M. Durkalec, National Veterinary Research Institute / Department of pharmacology and toxicology; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre Lead (Pb) mining has contributed to the extensive release of Pb into natural environments for centuries. In former mining districts, now on the Iberian Peninsula mainly livestock and hunting estates, Pb persisting in the soils and vegetation of affected areas may cause an environmental and health risk. Since Pb is a harmful metal, toxic for both animals and people, the need to know how to prevent or reduce exposure topeople. We studied the effect of commercial mineral supplements on Pb bioaccessibility through laboratory and field approaches. One aim was to prevent or reduce absorption in herbivores inhabiting mining areas and thus reduce the possible exposure route to people. In our previous work, we identified one mineral supplement rich in calcium (Ca) and phosphorus (P) that specifically altered Pb solubility and absorption in a digestive tract simulation model. Here, we go one step further to evaluate the effects of that commercial mineral supplement on Pb absorption and on immune status in goats from an old mining area. Two groups of goats from two plots with similar soil Pb concentrations were selected. One group was supplemented with the commercial mineral salt for 20 days, whereas the other once served as control. Then, the Pb exposure was evaluated in blood, milk and feces, and the phytosidae used qutest was used to evaluate T-cell-mediated immuneconsequence. Results showed that all goats responded to the PHA, but no significant difference was detected between groups. Blood and milk samples were collected the same days that the PHA skin test was conducted. Blood Pb levels in supplemented goats were lower than in control goats; in generalists; e.g. 44% of the 26 liver samples from the 2 groups according to the ratio with the mineral salt compared to 53% of the 26 liver samples from the 2 groups according to the ratio with the mineral salt. However, pollution mediated changes in leaf litter chemistry had no significant impacts on microbial litter colonization (bacteria/fungi ratio) and litter consumption by detrivore, confirming the high resilience of litter decomposition process to soil metallic contamination.

**TU302**

Analysis of anticoagulant rodenticides, neo-insecticides and fipronil in liver of predatory birds.


Pesticides in predatory birds have been drawing much attention worldwide in regard to species declining and protection. Pesticides are used for pest management of animal species such as commensal rodents and sap-sucking insects. However, pesticides can lead to secondary poisoning, when (predators) take 1,3,5-pentatriene as a forage, and they may bioaccumulate in the food chain. These compounds could affect whole species and the ecosystem. In some countries, Pb is detected in more than 70% of these samples. No sample showed Pb residues from primarily exposed target or non-target species. The analysis focused on anticoagulant rodenticides, neo-insecticides and fipronil which were regularly applied in the years 2011 to 2013. We obtained liver samples of 89 avian predators from this period, which were collected from veterinary institutions or private persons from 26 administrative districts in Germany. Avians were found dead or sick in these districts. We analyzed liver samples from 26 administrative districts for these compounds. The results showed that there was a clear detection of these compounds in the liver of predatory birds. These results show that the use of these compounds is not sufficient as a measure to reduce Pb exposure through milk consumption by the local human population.

**TU303**

Trophi Magnification of POPs including PFCs Within A Terrestrial Food-Web Of An Avian Top Predator, the Cooper's Hawk (Accipiter Cooperii)


K. Fremlin, SFU / Department of Biological Sciences; J.E. Elliott, Environment Canada / Science Technology Branch; F. Gobas, Simon Fraser University / Resource & Environmental Management

Protocols to assess bioaccumulation of POPs within terrestrial systems are far less developed compared to aquatic systems. Presently, regulatory agencies in Canada, the USA, and the EU use only bioaccumulation information for fish to assess the bioaccumulation potential of chemicals. However, recent studies have shown that some chemicals that are not bioaccumulative in aquatic food webs do biologically accumulate in terrestrial food webs. To better understand the bioaccumulation behaviour of chemicals in terrestrial food webs, we aim to produce a food-web model to assess the biomagnification of POPs in an apex avian predator, the Cooper’s hawk. Over 100 samples were collected from various trophic levels of the food-web including halibut eggs, songbirds, invertebrates, and berries. All samples were analysed for a number of contaminants listed as priorities for monitoring by the Chemical Management Plan of the Canadian federal government. Stable isotope analysis of δ13C and δ15N signatures of hawks, songbirds, invertebrates, and berries was used to estimate the trophic position of each organism. Legacy POP concentrations were expressed in terms of lipid equivalent concentrations to account for variability in the fractions of lipid and non-lipid organic matter measured in each sample. POP concentrations were expressed in terms of protein equivalent concentrations to account for the fraction of protein within each sample, which was estimated as the product of the percent of nitrogen measured in each sample and a nitrogen:protein conversion factor. Censored regression by maximum likelihood estimation was used to assess the relationship between the natural logarithm of each lipid or protein equivalent concentration and the trophic level, which was determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.

TU306
Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in temperate European rivers
K. Fremlin, SFU / Department of Biological Sciences; X. Wang, Xiamen University / Department of Environmental Science and Technology; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science

Biomagnification of lipophilic organic contaminants is one of the major pathways to accumulate xenobiotic substances in marine organisms. Interestingly, the magnitude of biomagnification is not necessarily consistent in organisms across the marine food chain. Triphenyltin (TPT) compounds, which is moderately lipophilic (log Kow ~3.5), are commonly used in antifouling paints on sea-going ship hulls and supports the marine herbivorous flatfish swarms in coastal waters of Hong Kong, Japan, and China. Studies have suggested that TPT can be biomagnified along the lower part of the trophic food chain (i.e., among primary producers, invertebrates, and fishes), while their magnification potential has remained unclear among the higher trophic organisms, such as larger fishes, dolphins, and seabirds. To date, only two studies have investigated whether TPT is biomagnified in higher trophic levels; however, their findings were contradictory. Therefore, we aimed to evaluate the biomagnification potential of TPT in high-trophic organisms across a spatial gradient from the more-contaminated western waters to the less-contaminated southern waters of Hong Kong. We have divided the western and southern waters into four sites, namely inner estuary (WI), outer estuary (WO), south of Lantau Island (SL), and southeast of Hong Kong Island (SE). Environmental (seawater and sediments) and biota samples (including molluscs, crustaceans, fishes and marine mammals) collected from the respective sites were analysed using gas-chromatography mass-spectrometry to examine the concentrations of six organotin compounds (i.e., mono-, di- and tri-butyltin; mono-, di- and tri-phenyltin). Preliminary results showed that seawater samples from WO had scantly measurable TPT. This is partially due to the abundant biogeochemical processes, such as various metabolic, transformation, and adsorption processes - all factors that may affect food webs in different manners. Terrestrial inputs can also directly and indirectly influence inputs, bioavailability and food web uptake of contaminants such as mercury (Hg). While several studies exist on effects of the increase in productivity and community composition of freshwater systems as well as bioaccumulation of contaminants, there is considerably less known about the trophic transfer dynamics. We characterised the expected physiological conditions, lower food web structure and Hg dynamics along a river-fjord continuum in southern Norway. Comprehensive water (surface and deep water) and zooplankton samples were collected on five occasions in 2015/2016. Physical-chemical parameters and nutrient concentrations were measured alongside data on chlorophyll a, bacterial as well as viral abundances and zooplankton composition. Methymercury concentrations in zooplankton were analysed and trophic position and food origin was established with the help of stable isotope measurements (δ13C and δ15N). Conservative mixing, reflected in the TPT concentrations, was directly related to structural features such as algal length and chlorophyll content. Conversely, MCCPs almost consistently displayed TMFs < 1, likely as a result of the sampling strategy and the data treatment. SCCPs exhibited TMFs in the range 0.4 – 2.0 and the extent of biomagnification was directly related to structural features such as algal length and chlorophyll content. Conversely, MCCPs almost consistently displayed TMFs < 1, likely as a consequence of their higher biotransformation rates compared to SCCPs. Such results provide additional data for the risk assessment of chlorinated paraffins.
TU308

Trophic transfer of Cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatinous zooplankton Aurelia sp. and Sanderia malayensis on crustacean Artemia sp.

E. Costa, C. Gambardella, V. Piazza, CNR ISMAR; S. Lavorano, Costa Eduttainment spa Aquario di Genova; M. Faimali, F. Garaventa, CNR ISMAR

Trophic interactions are a crucial vector of contaminant transfer in both aquatic and terrestrial ecosystems. In the marine environment, Cnidarian jellyfish are known to play an important role in food webs as major predators of metazooplankton and as prey of apex predators, influencing the microbial loop, through direct and indirect effects, besides regulating the marine biogeochemical fluxes. In this study, the potential contaminant transfer was investigated in simplified marine food chains. The nauplii of the brine shrimp Artemia sp. and the ephyrae of Aurelia sp. and S. malayensis were selected as primary and secondary consumers, respectively. Cadmium nitrate was selected as toxicant. Performed experiments consisted in feeding ephyrae, every 24 hours for 5 days, with nauplii of Artemia sp. previously exposed, for 6 hours, to different concentrations (0.1-0.5-1-2-4 mg/L) of Cadmium nitrate; this range was selected through preliminary trials aimed to define the cadmium LC50 value for crustacean larvae. At the end of feeding experiment (5 days), the effect of Cadmium nitrate treated crustaceans on ephyrae jellyfish was investigated by the “ingestion rate method”, the “predatory performance” and biometrics and bioenergetics parameters (Disch diameter, ash-free dry weight AFDW and gross growth efficiency GGE). In addition, 24 hours after each feeding treatment, two ecotoxicological end-points were evaluated on jellyfish ephyrae: Immobilization and Frequency of pulsation (number of pulsations/min).

Results showed a 100% of feeding rate and predatory performance in both control and treated jellyfish. (A. aurita and S. malayensis). Cadmium nitrate treated Artemia nauplii, once ingest, caused in ephyrae a decrease of Disch diameter and AFDW and also an inhibition of GGE% (Aurelia sp. ECU: 3.82 mg/L). As regards ecotoxicological assays, immobilization was never affected (effect < 50%), while frequency of pulsation showed a significant decrease after each feeding treatment. These findings suggest a contaminant transfer from crustacean nauplii to ephyrae able to induce sublethal effects.

TU309

Tissueular injuries in Crassostrea virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.

F. Mares-Guzman, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; G. Barrera Escorcia, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; X. Guzman-Garcia, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology

Essential metals uptake by organisms in small quantities carrying out their biological functions. In contrast non-essential metals do not have a known biological function. When metals are incorporated by the organisms they can cause damage and their presence indicates contamination. Several human activities contribute to the increasing load of both essential and non-essential metals in the aquatic/environment. Microalgae such as Chlorella sp., are the primary link in the trophic chain feeding and entering the environment, they can incorporate contaminants by absorption or adsorption. If these algaeaccumulate contaminants, such as metals, the organisms that feed on them like on the oyster Crassostrea virginica can in turn incorporate them through filtration, which may have negative consequences. The objective of this work 'n was to evaluate the effects derived from the trophic transfer of copper and/or cadmium from Chlorella sp. to C. virginica. Microalgae were grown for 110 h at a sublethal dose of copper and cadmium (0.1 mg/L). A concentration of 30 X 10^5 cells was given to C. virginica for 21 days. The evolution of histopathological lesions in C. virginica was evaluated in days 0, 5, 10, 15 and 20 of the assay. The analysis performed in the digestive gland revealed diverse lesions ranging from the loss of cilia and covering membranes, to the increase in the light of the digestive gland tubules, as well as the presence of various inflammatory processes. Other organs such as the gills, presented n inflammation and injuries that compromise the body's physiological processes/n such as feeding and breathing. These damages were evident after the first 96/n hours of exposure to the contaminated food. However, lesions found after exposure with cadmium exposure, a non-essential metal, in more than 50% of organisms/n could be observed on day 10 and those associated with more than 50% of animals in cooper exposure were deferred to day 15. The presence of Chlorella sp. in the digestive tract made possible to associate the injuries with trophic metal poisoning, and the prevalence of lesions with metal and exposure time.

TU310

Can microplastics save us? Effects of microplastic particles and particle-bound trace contaminants in an artificial aquatic food web

L. Hanslik, COS University of Heidelberg / Aquatic Ecology and Toxicology; A. Batel, University of Heidelberg / Aquatic Ecology and Toxicology; T. Brauneck, University of Heidelberg / Centre for Organismal Studies

Since 2015, studies dealing with toxic effects of microplastics in freshwater ecosystems come into focus. Still, little is known about vertebrate models as final consumers in food web experiments. The present study investigates the transfer of pristine microplastic particles and a model polycyclic aromatic hydrocarbon, along an artificial food chain with Artemisia spec. nauplii and zebrasphi (Danoia rario). Therefore, cryogenically grinded microplastic particles, made of polystyrene (P)

TU311

Toxicoecokinetics links predator-prey dynamics to assess zero-valent iron nanoparticles bioaccumulation in a Caenorhabditis elegans-Escherichia coli ecosystem

M. Yang, National Taiwan University / Bioenvironmental Systems Engineering; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; H. Lin, National Taiwan University; C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering

BACKGROUND: Zero-valent iron (Fe0) nanoparticles (NPs) are one of the most paramount NPs applied in environmental remediation that the potential impacts on the ecological dynamics and soil ecosystem health are of great concern. OBJECTIVE: The primary objective of this study was to simulate dynamic models linking bioinorganic and consumer-resource dynamics in the Caenorhabditis elegans (C. elegans)–Escherichia coli (E. coli) OP50ecosystem. METHODS: The bioinorganic parameters, uptake and depuration rate constants of bacteria and worms were obtained from toxicoecinetic experiments and related published literature. Biomass dynamics of bacteria and worms were estimated by employing the Lotka-Volterra model. Dynamic of Fe0NPs accumulations, biocenorrhization factors (BCFs), biomagnification factors (BMFs) were simulated based on the consumer-resource dynamics. A sensitivity analysis was also performed to characterize the influence of consumer-resource-related physiological parameters. RESULTS: Results showed that biomass of worms increased steadily from 22.25–51.61 g L⁻¹, whereas the biomass of bacteria decreased rapidly from 17.17–2.29 g L⁻¹ and attained a steady-state after 2 h of the simulation in the scenario of 100 mg L⁻¹ Fe0NPs exposure. We also observed that internal concentrations of Fe0NPs were estimated to be 67 and 1768.85 µg L⁻¹ in worms and bacteria, respectively. In addition, the BCF of bacteria was found to be 17.69, close to the experimental results. Moreover, the BMFs of worms were maintained to be consistently smaller than 1 during 24 h exposure. Results also indicated that internal concentrations of Fe0NPs in worms were mainly influenced by biomass conversion rate for bacteria ingested by worms, whereas parameter of death of worms had the smallest effect on worm internal concentrations. CONCLUSIONS: Model application to toxicoecinetic results confirms the hypothesis that the consumer-resource dynamics are effectively associated with Fe0NPs accumulations in bacteria and worms that the bioaccumulation kinetics and consumer-resource dynamics are likely to be dominated by the same physiological parameters.

Use of Effect Based Methods in the context of the national and european legislative framework for the protection of aquatic ecosystems (P)

TU312

INTEREST OF IN VITRO BIOASSAYS (YES/YEA) FOR THE SCREENING OF ENDOCRINE DISRUPTION IN SURFACE WATERS OF WALLOONIA (BELGIUM)

C. Chalon, ISSeP; Y. Meuffe, Inst. Scientifc de Service Public / Ecotoxicology Department; A. Claessens, Frippiat, ISSeP; K. Nott, SWDE; V. Brahy, F. Delloye, SPW-DGO-33E

This study is part of the BIODIEN project. This project aimed at conducting, for the first time, a screening campaign of endocrine disruptors (ED) in waters of Wallonia (groundwater, surface water and wastewater). Almost 200 substances were screened, including hormone estrone, alky/phenols, pthalates, chlorophenols,
perfluorates, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonist activities were also evaluated. Over 71 river samples (concerning 24 river sampling points from the regional monitoring network), estrogenic activity was detected and quantified in 53 samples and could reach levels up to 11.7 ng E2eq/l (mean: 2.1±1.6 ng E2eq/l). Androgenic activity was detected in the other hand, estrogenic and androgenic activities were detected in 42 % and 55 % of the samples, respectively. When the estrogenic activity was compared to the EU-Watch List Eqs for E2 (0.4 ng/l), 60 % of the samples exceed this value. The estrogenic activity was compared to the chemical results. A good correlation was found with the estrogenic concentration but also with other ED (e.g. bisphenol A, perfluorates). This study is, in a way, the first attempt in Wallonia to follow the recommendation for the use of effect-based methods (EBM) for monitoring of estrogens in surface waters emanating from the Science to Policy Interface (SPI) Estrogen monitoring project. These recommendations were presented at the last EU-WG chemicals held in October 2017 and this would possibly lead to the introduction of EBM in regulatory monitoring under the Water Framework Directive (WFD), especially for estrogens.

TU313
Ecotoxicological tools to assess the impact of pollution of tributaries to the Alqueva Reservoir (Southern Portugal)

P. Palma, Instituto Politécnico de Beja / Department of Technologies and Applied Sciences; S. Fialho, A. Lima, Instituto Politécnico de Beja; A. Penha, H. Novais, Instituto de Ciências da Terra; M. Marques, Instituto Superior de Agronomia; A. Lima, Instituto Politécnico de Beja / Department of Tecnologies and Applied Sciences; P. Alvarenga, LEAF - Instituto Politécnico de Beja / Department of Tecnologies and Applied Sciences; M. Poças, IDAEA-CSIC; P. Estaca, Instituto Superior de Agronomia; Universidade de Lisboa; M. Morais, R. Salgado, Instituto de Ciências da Terra; M. Marques, Instituto Superior de Agronomia; Universidade de Lisboa

Degradation of surface waters and biodiversity loss at different spatial and temporal scales occurs through multiple stressors whose effects are difficult to separate and identify. Efficient management of water bodies depends on the development and selection of robust, sensitive and easily applicable tools that allow prioritizing the pressures and stressors that act in a basin, and mitigate their effects. The Alqueva reservoir constitutes the most important water supply source in southern Portugal, a semi-arid region with high levels of water scarcity and where agriculture is one of the main activities. The aim of the present study was to assess the use of an ecotoxicological tool-box in tributaries of the Alqueva reservoir for detecting chemical alterations that may influence the water quality of the reservoir. Water samples were collected along 2017 at four tributaries of Alqueva (streams of Zebro, Alamos, Amieira and Lucefécit) and analyzed for: (i) physical chemical support elements (pH, temperature, dissolved oxygen, conductivity, chloride, total phosphorus, Kjeldahl nitrogen, ammonium, nitrite, nitrate, BOD, COD), (ii) hydro-ecotoxicological endpoints, using biotests indicating different trophic levels (Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna). In general, Zebro and Lucefécit presented concentrations of BOD (Zebro: 4.0-35.5 mg L⁻¹; Lucefécit: 2.3-7.5 mg L⁻¹) and total phosphorus (Zebro: 0.18-6.23 mg L⁻¹; Lucefécit: 0.02-1.92 mg L⁻¹) that compromise the support biological life, with regard to nutrient and oxygenation conditions. Concerning concentrations of metals, detection levels were low, being bentazone the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of bentazone of 1.94 µg L⁻¹), probably due to the intensive agriculture crops around it. Concerning to ecotoxicological analysis, the results highlighted the toxicity in sublethal parameters (reproduction, feed inhibition or growth inhibition) induced, mainly, by samples from Zebro and Lucefécit streams. So, the results from the ecotoxicological tool-box allowing identified the streams that promote a higher chemical impact to the reservoir, which is essential to delineate management actions to improve the water quality of the reservoir.

TU314
Effects based tools for use in conjunction with passive samplers

R.J. Brown, O.L. Tran, wca consulting; G. Whale, Shell Health / Risk Science Team; M.J. Spence, CONCAWE; D. Reverett, wca

As part of an ongoing review of the Water Framework Directive (WFD), the European Commission (EC) is considering “effects based tools” (EBTs) for use as an alternative to the chemical analysis to monitor surface water concentrations. There are several ways in which EBTs may be integrated into environmental monitoring but one approach, which integrates chemical exposure over time, is to conduct toxicity profiling on extracts from passive samplers deployed in surface waters. The aim of this project was to provide a critical evaluation of available EBTs that could be used in conjunction with passive samplers, and propose a list of assays for use in monitoring surface water concentrations. There are several ways in which EBTs may be integrated into environmental monitoring but one approach, which integrates chemical exposure over time, is to conduct toxicity profiling on extracts from passive samplers deployed in surface waters. The aim of this project was to provide a critical evaluation of available EBTs that could be used in conjunction with passive samplers, and propose a list of assays for use in monitoring surface water concentrations associated with the oil and gas industry. A list of possible EBTs was compiled based on recent published reviews on this topic. These assays were then broadly screened based on commercial availability, general validation maturity, previous application to environmental samples, and suitability for use with passive sampler extracts to derive a short list of 22 assays for more detailed consideration. The short-listed assays included novel whole organism bioassays (or surrogate), and in vitro or bacterial assays for endpoints based on endpoint disruption (oestrogen, androgen and thyroid), genotoxicity, oxidative stress, and metabolism of polycyclic aromatic hydrocarbons (PAHs). Commonly used whole-organism assays (e.g. Daphnia magna, algal growth, and fish embryo) were selected first, as they are already well proven and no detailed evaluation was required, however they were considered as part of the final recommendations. The shortlisted EBTs were then subject to a detailed review, based on the published scientific literature, to identify relevant information with respect to their performance, interpretation, and application. The EBTs were compared using the information identified in the literature review with an initial suite of thirteen bioassays were recommended for the monitoring of surface waters associated with refinery effluents using passive sampler extracts. This recommended suite of EBTs should be considered a starting point for use in the monitoring of waters receiving refinery effluents, to be further developed based on experience in using the assays for this purpose, and incorporating new relevant bioassays once they have achieved a sufficient level of validation maturity. This review will be published as a Concawe report in 2018.
(predicted no effect concentration). Ecotoxicological effects have been detected with the algae and could be related to the substances detected (e.g. heavy metals) or other substances released in the area (transitional waterbody). In general the results show a situation in which the quality of the sediments is not in a good status, although the level of concentrations should not cause a high risk for the aquatic ecosystems; the chemical contaminants can derive from different sources of pollution (industrial, urban, agricultural, atmospheric deposition) and may causing mutagenicity. The research was therefore on the ide.

**TU317**

**USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSOME ASSAY FOR THE IDENTIFICATION OF MUTAGENIC PROFILES IN WATER SAMPLES AND SUSPENDED PARTICULATE MATTER**

D.A. Morales, State University of Campinas / Faculty of Technology; J. Rossetto-Martins, Zwar, School of Technology, UNICAMP; R. Massei, Helmholz Centre for Environmental Research. UFZ / T.C. Schmidt, University of Duisburg-Essen.

The objective of this study was to use different strains for the identification of mutagenic profiles and hinting at the class of compounds responsible for the detected mutagenicity. The research was performed with organic extracts of surface water and suspended particulate matter (SPM) collected in 13 different sites along the Danube River during the Joint Danube Survey 3 (JDS3).

The extracts were evaluated with the Salmonella/microsome microsomal activation assay and cytoplasmic activation (TA98, YG1041, TA1538 and YG1585) with specific genetic characteristics for the detection of different compounds. A total of 69% surface water and 92% SPM samples were positive for at least one strain/condition. The applied methodology compared the profiles obtained at different sites along the Danube River. This in vivo approach may be used for the identification of various classes of organic pollutants in surface waters that are causing mutagenicity. We conclude that aromatic amines and nitro compounds for surface water and also polycyclic aromatic hydrocarbons for suspended particulate matter appear to be responsible for mutagenicity at some of the sites, because the obtained profile were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures that are responsible for the observed mutagenic and genotoxic effects. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-5. José Ricardo R. M. Zwar thanks FAPESP Project 2015/11399-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship. The SOLUTIONS project has received funding from the European Unions Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603437.

**TU319**

**Imposex levels in gastrophods from the Northern Adriatic Sea (Italy): a proposal of classification according to the Water Framework Directive**

F. Cacciatori, ISPRA-Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; R. Boscolo Brusà, C. Antonini, M. Fenalewicz, ISPRA - Institute for Environmental Protection and Research; M. Marin, University of Padua; A. Bonomari, M. Gabelini, ISPRA - Institute for Environmental Protection and Research; butyltins (BTs) - i.e. mono-(MBT), di- (DBT) and tributyltin (TBT) - are synthetic compounds worldwide used in industrial and agricultural applications giving rise to contamination of aquatic environments. Organotins, which include BTs, were banned on antifouling paints, the main route to aquatic pollution, by Reg. 782/2003/EC. Presently, due to their persistence, toxicity and bioaccumulative properties, TBT compounds are included among the priority hazardous substances according to the European Water Framework Directive (WFD) and its daughter Directive 2008/105/EC. Imposex, the superimposition of male sexual characteristics on females of gonochoristic gastrophods, is the most studied effect of TBT exposure and it is generally recognized as a specific water quality and aquatic pollution indicator. For this reason, under the implementation of the WFD, imposex measurements have been indicated as a useful tool to link chemical and ecological status assessment. In this context, the aim of this study was to propose a classification of imposex according to WFD using two species of gastrophods collected in the Northern Adriatic Sea and in the Venice Lagoon: *Nassarius nitidus* (Jeffreys, 1867) and *N. babylonicus*, which are more sensitive to BT pollution, can be found in the inner parts of the lagoon, whereas the latter, more sensitive, occurs only near the lagoon inlets or in the sea. To define Ecological Quality Ratio (EQR) class boundaries within WFD, the relationship between the ecological impact caused by BT pollution and the reproductive capacity of the gastrophods populations was assessed. This preliminary attempt showed that most of the sites were in Bad ecological status before the ban and have reached mostly a Moderate status at present, with very few sites in Good or High status. A comparison between the two species was also performed showing advantages coming from the combined use of both species to cope with the ecological quality assessment in a wider study area.

**TU320**

**Lessons Learned from Sibro Dam and River Restoration in Sweden**

E. Hallqvist, C. Becker, P. Böndöökke Adamsen, P. Gliosven, A. Sahlen, Ramboll Aquatic ecosystems in the European Union are under pressure from growing demand for/insufficient quantities of good quality water for human use. The Water Framework Directive (WFD) aims to protect and improve aquatic ecosystems; environmental quality standards (EQS) have been established as legal tools with which to set requirements for/unmember states. In Sweden, all major surface waters are classified according to the current/unstatus of the water designated by authorities in the respective water district. The ecological/unstatus of surface water comprises three different types of quality factors according to the Directive - biological, physico-chemical and hydro-morphological. The latter defines/inconnectivity and biodiversity in the ecosystem, since many aquatic organisms are/depend on the ability to migrate during their life cycle. Water power represents a large/infraction (almost 50%) of electricity production within the country, and a large proportion of Swedish rivers are affected hydro-morphologically. At present, there are 11,000 active and/abandoned dams in Sweden, 12,600 rivers and 1,800 are hydroelectric power plants. All of these dams impact the ecological connectivity of rivers and have a negative impact on/biodiversity. In Sweden, a common national strategy is to use the idea of hydropower/plants as an alternative to reliance on fossil fuels. In the same time water power is the/creates individual cause of physical impacts in lakes and streams. The challenge at this/early stage of Sweden’s national energy strategy is to identify technologies and management practices that promote hydroelectric power with minimal long-term adverse/ecological impacts. To illustrate the challenges, this paper summarizes work conducted/un the past 2 years to manage the future of the Sibro Dam located in southern-central/Sweden. The project was initiated after previous dam repair work involving the diversion of/a large earthwork in the Sibro Rams a serious impact to protect and improve consequences for nationally protected/indigenous mussel species and other aquatic life. The responsible municipality is obligated to/improve ecological connectivity at Sibro Dam and regulation of Lake Bäven. The planning/working included preparation of an environmental impact assessment (EIA), detailed/engineering design for fish passage, engagement with local communities and communications between the municipality of Nyköping and Sweden’s federal court/itsFish passage; Sweden; ecological connectivity; environmental impact assessment

**TU321**

**Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment (P)**

Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish
Characterize endocrine disrupting effects of EE2 in coral reef fish, with an emphasis on social behaviors. For the exposure experiment, the fish were randomly distributed to separate tanks to form small colonies consisting of three individuals and were exposed to an environmental concentration of EE2 (30 ng/L) for 4 weeks. During this period, social behaviors including agonistic behavior, submissive response, and shelter utilization were videotaped and quantitatively analyzed once a week. Our results show that growth and survival were significantly affected by social behavior, while EE2 treatment had no significant effect. Some behaviors were not altered, but social behaviors of the middle-ranked fish were significantly affected by EE2 suggesting that EE2 may cause different impact in different ranks.

TU324 Impacts of environmentally realistic antidepressant exposure on reproductive behaviour and sperm traits in fish J.M. Martin, M. Saaristo, Monash University / School of Biological Sciences; M.G. Bertram, Monash University / Biological Sciences; S. Hanington, J. Tanner, Monash University / School of Biological Sciences, Monash University, Victoria, Australia; M. O’Bryan, Monash University / The Development and Stem Cells Program of Monash Biomedicine Discovery Institute and the Department of Anatomy and Developmental Biology; B.B. Wong, Monash University / School of Biological Sciences

Pharmaceutical contaminants are increasingly being detected in ecosystems worldwide. Indeed, more than 1 in 10 currently manufactured pharmaceuticals have been found in the environment. One pharmaceutical pollutant of environmental concern is the antidepressant fluoxetine, which has repeatedly been reported in aquatic ecosystems. Worryingly, the primary target molecule of fluoxetine is conserved across a wide range of non-target species. As a result, by directly acting on the central nervous system and neuroendocrine pathways, fluoxetine can affect a range of ecologically important behavioural and physiological processes in wildlife. Despite this, the effects of environmentally relevant fluoxetine exposure on processes of sexual selection in aquatic biota remain uncertain. This is concerning as sexual selection processes directly influence mating outcomes and so are fundamental to individual fitness, as well as the viability of populations and species. To address this knowledge gap, we investigated the impact of 30-day exposure to environmentally realistic levels of fluoxetine (average measured concentrations: 30 and 380 ng/L) on a range of reproductive behaviours, as well as sperm quality, in the eastern mosquitofish (Gambusia holbrooki), a promiscuous freshwater fish with internal fertilisation. We focussed on these traits because reproductive behaviour and sperm quality are both crucial fitness determinants, and are known to be vulnerable to disruption by other chemical pollutant classes. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviour (mutual swimming). Gammarus pulex (Gammaridae), a common freshwater amphipod exposed to environmentally realistic antidepressant exposure, however, did not significantly impact sperm quality measures (i.e. performance and viability). In combination, our results indicate that fluoxetine exposure can alter reproductive behaviours with direct bearing on fitness in fish and, further, highlight the need for ecotoxicological testing using sub-lethal exposure concentrations and ecologically important behavioural endpoints.

TU325 Determining the effects of antidepressants on multiple behaviours in a marine and freshwater amphipod S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth / Animal Physiology and Ecotoxicology

Behavioural tests have been gaining recognition as a viable endpoint in ecotoxicology as they provide a link between biochemical and ecological effects of environmental contaminants. Psychotropic drugs are designed to modulate behaviours in humans, and preclinical studies have demonstrated that these compounds can also alter behaviours in aquatic vertebrates. The effects of behavioural modulating drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined behavioural assays. These pharmacological methods have been translated to ecotoxicological studies on vertebrates but comparably few have been done on invertebrate species. This ongoing study aims to translate these techniques to model crustaceans for the purpose of assessment of environmental risk using the antidepressant fluoxetine as a model compound. Specimens of the marine amphipod, Echinogammarus marinus and the freshwater amphipod Gammarus pulex were exposed to environmentally relevant concentrations of fluoxetine from 0.001-1 μg/L during 1 day, 1 week, and 2 week exposures. Activity was measured as swimming velocity and choice experiments were used to determine phototactic and thigmotactic response. Both E. marinus and G. pulex showed alterations in activity at concentrations as low as 1 ng/L and as soon as 1 day compared to controls (P<0.05). Significant differences were observed in thigmotactic and phototactic behaviours between both treatments and with length of exposure. Results indicate that fluoxetine can have an effect on some amphipod behaviours at environmentally relevant concentrations. These results may have implications for future study design of these types of experiments and aid the development of high-throughput analysis on common laboratory invertebrate species.
TU326
Inter-species variability in the behaviour of a marine and freshwater amphipod
S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth

Individual species are used in standard ecotoxicology testing to assess environmental effects of contaminants. However, standardised invertebrate models are limited to relatively few species. Behavioural ecotoxicology is expanding with techniques and endpoints used in pharmacology being translated to other vertebrate and invertebrate species for use in ecotoxicology. Despite this, data on the control behaviours of model organisms such as crustaceans, and the inter-species variability in behaviours are currently under-studied. The aims of this study were to provide control data on a range of behaviours for use in ecotoxicological testing, using amphipods as model organisms. Behaviours commonly associated with anxiety in pharmacological studies including activity, phototaxis (light/dark preference) and thigmotaxis (wall hugging) were assessed in the marine amphipod *Echinogammarus marinus* and the freshwater amphipod *Gammarus pulex* using choice assays. Both organisms exhibited negative phototactic and positive thigmotactic behaviours (P<0.001 respectively) however, differences in sensitivity to these assays were observed between species. *E. marinus* showed a significantly greater sensitivity to the phototaxis assay than *G. pulex* (P<0.001), while the reverse was found for the thigmotaxis assay (P<0.001). Swimming velocity was used as a measure of activity. Significant differences were observed in swimming behaviour between species when exposed to a light stimulus (P<0.001) which may be attributed to differences in life histories between the two species. The results of this study provide evidence of phototactic and thigmotactic behaviours in two model crustacean species and describes two behavioural assays with potential for use in behavioural ecotoxicology. In this study we demonstrate that closely related species are capable of very different behavioural responses. The inter-species variability in sensitivity to behavioural assays found between the two amphipods in this study highlights the importance of control data on your model species for behavioural studies.

TU327
Physiological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)
L. Vosseg, Uppsala University / Department of Neuroscience; J. Fick, Umea University / Department of Chemistry; T. Brodin, Umea University / Department of Ecology and Environmental Science; S. Winberg, Uppsala University / Department of Neuroscience

 Physicochemicals are common contaminants in aquatic ecosystems. Among the most prescribed pharmaceuticals globally are the benzodiazepines (e.g. Valium), a class of psychoactive drugs used to treat anxiety and induce sedation. Benzodiazepines are persistent in the environment, and their target, the GABA-A receptor, is evolutionarily conserved throughout the vertebrates. Behavioural changes have been described for juvenile Eurasian perch (*Perca fluviatilis*) and Fathead minnows (*Pimephales promelas*) at environmentally relevant concentrations. GABA-A receptors are ligand-gated chloride channels containing subunits that activate upon binding of the neurotransmitter GABA. If we are to mitigate the effects of benzodiazepine pollution, it is important to understand the mechanisms underlying behavioural changes and their genetic basis. Recent findings from our lab show that GABA-A receptors are highly sensitive to environmental stressors and that this sensitivity is heritable, allowing the individual’s behavioural tolerance to be predicted. This is particularly relevant in environmental contexts where individuals may be exposed to sub-lethal concentrations of benzodiazepines. In this study we explore how GABA-A receptor expression is affected by the presence of benzodiazepines, and the possible impact on the individual’s behavioural response.

TU328
Reversible behavioural alterations in burbot, Lota lota, from exposure to environmentally relevant levels of oxazepam
J. Sundin, Norwegian University of Science and Technology / Department of Neuroscience; F. Jutfelt, Norwegian University of Science and Technology / Department of Biology; J. Fick, Umea University / Department of Chemistry; M. Thorlacius, Marine and Freshwater Institute; T. Brodin, Umea University / Department of Ecology and Environmental Science

Benzodiazepines are frequently detected in wastewater effluent and can be found at high concentrations in treated effluent. They persist in wastewater efﬂuent and can be found at high concentrations in treated efﬂuent. Furthermore, several benzodiazepines are resistant to photodegradation, enabling them to persist in the environment. Benzodiazepines are designed to alter human behaviour by binding to GABA-receptors, which are found in a wide range of animals including all vertebrates. We investigated the effect of the benzodiazepine oxazepam on behaviour using the burbot, Lota lota. We found that high levels of oxazepam affected swimming activity, diurnal as well as nocturnal, while the environmentally relevant level had no detectable effect. There was also an effect on boldness, with fish exposed to high levels of oxazepam spending more time hiding than the control- and low level fish. Interestingly, the effects of high oxazepam were no longer detectible when the fish were tested again after being kept in water without drugs for five days. Our results suggest that effects of pharmaceuticals may be reversible, if the exposure duration is relatively short and the animal have the possibility to move to uncontaminated water.

TU329
Behavioural endpoints and biochemical biomarkers as tools to investigate effects of Citalopram in brown trout (Salmo trutta f. fario)
M. Ziegler, University of Tubingen / Animal Physiological Ecology; S. Tisler, University of Tuebingen / Environmental Analytical Chemistry; L. Reinhrt, University of Tubingen / Animal Physiological Ecology; R. Triebskorn, University of Tuebingen / Animal Physiological Ecology

Citalopram (CIT) is a selective serotonin reuptake inhibitor (SSRI) which is commonly used as an antidepressant. It binds to serotonin reuptake from the synaptic cleft and thereby inhibits the reuptake of serotonin into the pre-synapse. Due to high consumption rates and moderate elimination during wastewater treatment, CIT is one of the most abundant SSRIs in surface water. Several studies showed that environmentally relevant concentrations of 1 µg/L may affect aquatic organisms. The aim of this study is to investigate effects of CIT in different life stages of brown trout (*Salmo trutta f. fario*) with focus on development, behaviour and individual health. Both, eggs of the fish in the eyed ova stage and 8 months old juveniles were chronically exposed to four concentrations of CIT (1, 10, 100 and 1000 µg/L) in a in a semi-static three-block design accompanied by a control exposure. The larvae were exposed for 5 month at 7°C and 11°C, the experiments with juvenile fish were conducted for 4 weeks at 7°C. To investigate the effects of CIT on the embryonic development, mortality, hatching rate, and heartbeat rate were recorded. During the exposure, also behavioural endpoints were observed. Besides, several biomarkers indicative for fish health were investigated, such as cortisol-level, acetylcholinesterase activity, hsp70-level and the histological condition of the liver. After exposure to 1000 µg/L CIT, length and weight of both larvae and juveniles were significantly reduced. Furthermore, both stages showed an increased swimming activity and an increased swim up in the aquaria. In an artificial swimming measurement device (small aquaria with a diameter of 17 cm), videos were recorded for 20 minutes with the aim to quantify changes in the swimming behaviour. Due to the settings of the cameras, the aquaria were strongly illuminated and the water was not ventilated during the recording. This stress situation resulted in a high activity of fish for those exposed to 1000 µg/L CIT. These moved significantly less with a lower velocity than the control fish. The results of both experiments make evident that 1000 µg/L CIT affects both larvae and juvenile brown trout, on one hand by making them more agile in the aquaria, but also by depressing stress-induced flurry swimming. The study is embedded in the Effect-Net (effect network in water research) Project which is funded by the Wassernetzwerk Baden-Württemberg.

TU330
Assessing the direct and indirect effects of chemical contaminants on the behaviour, ecology and evolution of wildlife: A conceptual framework
K. Arnold, University of York / Environment; M. Saaristo, Monash University / School of Biological Sciences; T. Brodin, Umea University / Department of Ecology and Environmental Science

Chemical contaminants, e.g. metals, pharmaceuticals, pesticides, are changing ecosystems via effects on wildlife. Most studies examine a limited range of endpoints, species or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants have direct and indirect effects at multiple levels of organisation by affecting physiological and biochemical processes. Indirect effects are expected to exert cascading forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we supply tools to design ecologically realistic experiments and risk-assessments. Although predicting effects of contaminants is complex, existing knowledge in explicit based in ecological realism, however, reveals that chemical contaminants have direct and indirect effects at multiple levels of organisation by affecting physiological and biochemical processes. Indirect effects are expected to exert cascading forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we supply tools to design ecologically realistic experiments and risk-assessments. Although predicting effects of contaminants is complex, existing knowledge in ecological and evolutionary processes can be used to specify more realistic hypotheses for further research. Behavioural endpoints and biochemical biomarkers as tools to investigate effects of pharmaceuticals in fish

TU331
Scent and sensibility: EE2 disrupts male mate choice in fish
M. Saaristo, C.P. Johnstone, Monash University / School of Biological Sciences; K. Xu, University of Alberta / Department of Renewable Resources; M. Allinson, The University of Melbourne / School of Chemistry; B.B. Wong, Monash University / School of Biological Sciences

Among the handful of studies that have studied the behavioural effects of endocrine disrupting chemicals (EDCs), only a few have attempted to disentangle the mechanisms underlying behavioural changes, such as mate choice. In fish, for example, ecological studies have shown that males base their mate choice on
multiple cues and both visual and chemical cues play an important role in choosing the most suitable mate. Therefore, it is crucial to understand if and how EDCs affect mate choice cues (e.g. visual and chemical cues), and further, if one cue is affected disproportionally. Accordingly, the aim of this study was to investigate the impacts of a 28-day exposure to 17α-ethinyl estradiol EE2 (measured concentration 12ng/L) - a synthetic estrogen used in the contraceptive pill and a widespread contaminant of aquatic systems - on visual and chemical communication in the guppy. To examine the impact of EE2 on mate choice, we ran a standard choice assay, which was conducted in two parts to disentangle visual cues from chemical cues. First, we allowed a single male (either control or EE2) to court two size-matched females (one control and one EE2-female). In this visual cue experiment, the male was only able to see the females, but not to smell them. Second, we introduced chemical cues (control and EE2-female) to the trial tank paired randomly with the females. We found that there was no significant effect of EE2-treatment on total time males spent associating with the females, when given only visual cues. There was, however, a significant effect on courtship ‘sigmod’ display with both control and EE2-exposed males spending more time performing sigmod displays for control females compared to EE2-exposed females. When mates were presented with chemical cues (control and EE2-female), males exposed to EE2 entered the association zone more frequently, if EE2-exposed female was paired with an EE2-chemical cue. In contrast, sigmod display showed a reverse pattern, with males preferring EE2-exposed females that were paired with control chemical cues. Not only does our study uncover a previously unknown behavioural impact of EE2-exposure on chemical cues, but also raises the possibility that EE2-exposed males might try to associate with females that have been exposed to EE2. Our results underscore the importance of studying multiple mate choice cues simultaneously, and highlights the possible ecological implications of altered chemical communication for exposed wildlife.

TU332 Effects of tributyltin on the eyes, swimming, feeding and growth of newborn guppies Poecilia vivipara
D.V. Paulo, C.F. Mariz Jr, M.K. Alves, R.M. Barata, UFPE Universidade Federal de Pernambuco / Department of Zoology; R.N. Alves, UFPE Universidade Federal de Pernambuco / Zoology; P.S. Carvalho, UFPE - Universidade Federal de Pernambuco / Zoológica.

Although the use of the antifouling contaminant tributyltin (TBT) has been banned since 2008 by the International Maritime Organization, it still persists in coastal environments due to its remobilization from contaminated sediments and also as a result of illegal use, including tropical regions along the Brazilian Atlantic Coast. Poecilia vivipara is a promising model for tropical estuarine fish ecotoxicological studies, and we focused here on its feasibility to address fish early life stage toxicity. Our histopathological changes of the retinal pigment epithelium (RPE) indicated a hyperpigmentation of the pigment epithelium villi and basal region in TBT exposed females. Newborn Poecilia vivipara fish at six days after birth (dab) obtained from a laboratory breeding stock were exposed for 96h to waterborne TBT-1 μg TBT L-1, plus controls and solvent controls. After exposure, we evaluated swimming speeds and trajectories of the fish, counter-current swimming resistance, ability to capture Artemia nauplii, growth in weight and length, and histopathological changes of the eyes showed a darkening of the iris region after exposure to 4.5; 7 and 9 μg TBT L-1. Histopathological analysis of the retinal pigment epithelium (RPE) indicated a hyperpigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. After exposure to 7 μg TBT L-1, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 33.6% and 56% relative to controls, respectively. The histopathological changes detected in the retina and iris may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints might have led to a deficiency in prey capture and growth. These changes can reduce the chances of exposed fish to recruit to the adult population.

TU333 Chemosensory behavioral reactions of zebrafish larvae to environmental contaminants
S. Kaul, J. Richau, C.M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology.

Background: Selecting an appropriate behavioral response to a potential rewarding or threatening stimulus is critical for the survival of an animal. Therefore, organisms possess an innate ability to act towards threatening and rewarding situations they are naturally exposed to. However, the ability to naturally respond to environmental cues may be negatively affected by contaminants. As a consequence, the behavioral outcomes become unpredictable. In particular, neuroactive and psychoactive substances in the aquatic environment released by wastewater treatment plants or agricultural run-offs might potentially change the perception and interpretation of natural cues by aquatic organisms, especially fish. Aim: We are investigating whether environmental contaminants lead to attractive or aversive responses in fish, and are additionally interested in the neuronal mechanisms underlying the observed behavioral response. We aim to better understand how environmental contaminants change natural behavioral responses of fish in order to better predict their impact on the ecosystem. Methods: We are using zebrafish larvae as a model organism, because they are amenable for behavioral analysis and mechanistic dissection of complex processes. Larvae are exposed to a point source of test chemical at different concentrations and the behavior is tracked with an automated video recording system. Various parameters such as the larva’s space use, locomotor activity and velocity are evaluated. Active and aversive responses in fish were defined by the larva’s position and swimming behavior in the arena. Behavioral responses were classified into 5 categories: turning away, avoidance, attraction, risk-assessment and no response. Results: Chemosensory behavioral responses were identified at 1 μM, expressed by an increased dwell time in the nicotine containing zone. Higher concentrations (10 μM), on the other hand, appear to be clearly aversive, and larvae tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with according activation or inhibition of the reward center in the telost brain. We are investigating whether neuroactive contaminants (Imidacloprid, Thiacyloprid) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Oxazepam) found in European waters trigger similar behavioral patterns. Outlook: We will dissect which chemosensory system and higher brain areas are involved in the behavioral reactions to environmental chemicals. This will advance our understanding of the impact of chemicals on fish behavior.

TU334 Urban sewage effluents into an alpine stream: are information on behavioural effects on Daphnia magna suitable to protect alpine cold adapted species?
V. Di Noci, University of Milan - Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; V. Lencioni, F. Bellamoli, MUSE-Museo delle Scienze, Dept. of Science and Culture, Trento / Department of Earth and Environmental Sciences; C. Ferrario, University of Milano Bicocca, S. Villa, EMA European Medicines Agency

Even if identified as pristine, mountain freshwater ecosystems could be threatened by chemical pollutants through the discharge of effluents from wastewater treatment plants (WWTPs), a well-known source of several emerging contaminants (EDCs) such as pharmaceuticals and personal care products that have been detected in different alpine rivers downstream of WWTPs. Acute toxicity tests performed with Daphnia magna are among the most internationally used bioassays for monitoring the toxicity of effluents. However, acute toxicity tests do not take into consideration endpoints that may provide early warning signals about the health of the exposed populations, such as behavioral changes. Altered behavioural signals could be induced at sublethal concentrations which are significantly lower than the corresponding L(E)C50. In this study, we compared the sensitivity as mortality and swimming of Daphnia magna, and Diamesa cinerea gr.larvae, a chironomid (Diptera Chironomidae) common in cold freshwaters in the Alps, often associated to pristine environments. Both organisms were exposed for 24 and 48 hrs to different dilutions of effluents collected from a WWTP located at the Tonale Pass locality, in Trentino (1799 m.a.s.l, NE Italy). The aim was to verify if D. magna could be employed in biomonitoring programs for WWTPs located in Alpine areas as surrogate of cold freshwater best adapted species. Mortality rate and behavioural responses (as swimming, analysed with two video tracking systems: LoliTrack System and ImageJ/mwTRick) were compared. We found that D. magna was more sensitive to the treatment in the acute toxicity tests and higher sensitivity of D. magna than Diamesa gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

TU335 Do silver and titanium dioxide nanoparticles influence the fish kairomone induced anti-predator defence in Daphnia magna?
A. Beasley, University of Siegen; S. Hartmann, University of Siegen, Institute of Biology / Department of Chemistry and Biology; K. Witte, University of Siegen / Department of Chemistry and Biology.

Daphnia possess a trait of phenotypic plasticity, whereby kairomones from fish induce growth and the formation of structures such as a spine or helmet. The resulting increase in body size, allows the daphnids to defend themselves from the predators in their natural environment. As the common link between green algae and fish in the food chain, daphnia are considered a key component in the freshwater food system. Degradation of the silver nanoparticles is therefore necessary, to prevent an ecological imbalance in the freshwater environment. Ag and TiO2 manufactured nanomaterials (MMNs) are widely used in the commercial industry because of their unique properties. Silver is known for its antimicrobial properties and is therefore used in soaps and bandages as well as clothing and washing machines. Titanium on the other hand is used in products such as sunglasses, paint and toothpaste because of the bright white pigment it contains. Due to their small size, nanoparticles are not being effectively removed from wastewater treatment plants and end up in freshwater systems such as rivers and streams. Filter feeders, like the cladoceran Daphnia, take up these nanoparticles and
are therefore of particular scientific interest, to establish what impact the MNMs are having on the freshwater cycle and food-chain. In our study, we investigate the effects of Ag (NM300K) and TiO2 (NM105) MNMs on the predator defence response; by chronically exposing Daphnia magna to fish kairomones and a range of nanoparticle concentrations. This experiment was conducted in accordance with OECD guideline No. 211 over a course of 21 days. For statistical analysis, we measured the body length, body width and tail spine length after each moult and compared these parameters with respect to untreated control. As reported in many previous studies, no differences in moult interval and tail spine length of the experimental group were observed. A sample size of 10 animals was taken of each daphnia at the end of the experiment, to observe and compare the microscopic details of the anti-predator defences in the treated and untreated daphnia.

TU336
Behavioral and Physiological Responses of Daphnia magna to Fluoxetine and Propanolol Exposure
M.E. Nielsen, P. Rosley, Aalborg University / Biology and Environmental Science Fluoxetine and propanolol are neuroactive human pharmaceuticals that occur as pollutants in surface waters. The potential effect of such pharmaceuticals on aquatic organisms including invertebrates has raised some concern but many adverse effects are not well characterized. In this study, 6 behavioral and physiological parameters in the freshwater Cladoceran Daphnia magna were compared for their responses to fluoroxetine and propanolol exposure: mobility (dichotomous response), active swimming time, swimming distance, swimming velocity, swimming acceleration speed, and survival in the absence of food (starvation survival). Changes in swimming behavior of D. magna were quantified by video tracking of single organisms followed by image analyses. Active swimming and swimming distance appeared to be more responsive behavioral endpoints than swimming velocity and swimming acceleration. The EC50s for fluoroxetine and propanolol determined from swimming time and swimming distance were comparable (1-2 µg/L). At low sublethal exposure concentrations (µg/L), non-monotonic responses in swimming behavior were observed in D. magna. Behavior profiling estimated from multiple behavioral parameters showed that fluoxetine and propanolol stimulate swimming activity at 1-10 µg/L. EC50 values for fluoroxetine and propanolol estimated from survival time in the absence of food (starvation-survival) were much lower than EC50 values estimated from changes in swimming behavior. Starvation-survival is strongly affected by energy metabolism and we suggest that this parameter can be a potential sensitive endpoint for determining adverse effects of pharmaceutical to D. magna. Combining behavioral and physiological responses to high and very low exposure concentrations should be considered in models predicting adverse effects of pharmaceuticals to non-target organisms.

TU337
How toxic is a non-toxic nanomaterial: Behaviour as an indicator of effect in Danio rerio (zebrafish) exposed to nanogold
T.Bohne, North-West University / School of Biological Science; S. Brand, North-West University; V. Wepener, North-West University - School of Biological Science and Technology.
Gold nanoparticles are used as drug delivery vectors based on the assumption that they have a low toxicity. Literature has however showed conflicting results over the last few years. This study aimed at investigating the toxicological effects of nanogold (nAu) over a range of indicators from sub cellular to whole organism level. Gene regulation, changes in oxidative stress biomarkers and swimming performance were assessed in Danio rerio (zebrafish) following exposures to nAu. Adult zebrafish were exposed to nAu for 96 hours, swimming performance was measured post exposure. Liver tissue was collected for DNA microarray and Real Time Polymerase Chain Reactions (RT-PCR) analyses to determine changes in gene expression (catalase, superoxide dismutase and metallothioneins). Whole body samples were stored in respective buffers for protein biomarker analysis (catalase, superoxide dismutase, acetylcholine esterase, malondialdehyde, cellular energy allocation and metallothionein). Swimming behaviour was assessed in 11.1 L Tecxiplast™ tanks for a period of six hours and videos were analysed using Noldus EthoVision software. The critical swimming speed was performed in a LoloBio swimming tunnel, briefly fish were acclimatized within the chamber for one hour and then at a starting speed of 2 b/s with a 0.5 b/s speed interval, fish were swum until they were unable to keep up with the increasing water flow. The DNA microarray revealed that 20 mg/L was the least related to the control group. At 20 mg/L there was a significant increase in gene expression for all genes analysed but protein biomarkers showed no significant response. The behaviour results showed significant changes in distance moved, swimming speed, acceleration bouts, zone alterations and time spent within the top zone - responses which are seen in fish responding to toxicological stress. The exposed fish has a significantly lower critical swimming speed when compared to the control. Since swimming performance and social interaction during swimming is essential to life whole organism behaviour shows a toxicological response to nAu which is in agreement with genetic responses seen.

TU338
The effects of silver and silver nanoparticles via different routes of exposure on behaviour in marine amphipods
M. Vannucci-Silva, UNICAMP / Institute of Biology; S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; G. Umbuzeiro, School of Technology, UNICAMP / LAEG; A. Ford, University of Portsmouth / Biological Sciences. Behavioural responses are an important endpoint because they provide a link between biochemical and ecological effects of environmental contaminants. Silver is increasingly being used in nanomaterials and, consequently, being released into the environment in different forms. The behavioural consequences of metal exposure in crustacean may be of environmental concern. Therefore, the aim of this work was to evaluate the effects on the swimming behaviour of the marine amphipod Echinogammarus marinus after exposure to silver, in its salt (AgCl and AgNO3) and nanoparticle (E. marinus (n=20 per treatment) were exposed individually. The exposure via water was performed with Ag (from AgCl) or AgNO3 at 0; 5; 25 and 100 µg/L for 96 hours. In the exposure via food, the animals were fed on alternate days with control food or food impregnated with AgCl or AgNP (approximately 200 mg kg^-1) during 7, 14 and 28 days. The movements of the amphipods were tracked using a DanioVision™ system with EthoVision®XT software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in speed, swimming, response to light and thigmotaxis were evaluated. In the Ag exposure via water, light significantly increased maximum velocity for all treatments (p<0.05) indicating an escape-related behaviour; excepting at 100 µg L^-1, where the maximum velocity had no difference. The results that not at a concentration had a significant effect on the response to light; no significant effects were observed in frequency in centre zone for all treatments (p>0.05), although, cumulative duration in centre zone was significantly different using 25 µg/L of AgNO3, however, when animals spent more time in the centre zone when was dark. Results from the exposure via food are currently undergoing analysis. The current results indicate that silver has effects on swimming and response to light behaviours in E. marinus, indicating that exposed animals in the environment could be more vulnerable to predation. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP 2016/1963-5) for financial support. We also thank Professor Dr. Theodore Henry from Heriot-Watt University for providing the food (control, AgCl and AgNP) used in the feeding exposure.

TU339
Studying methods to determine aquatic invertebrate behavioural endpoints for regulatory ecotoxicology studies
Developing methods to determine aquatic invertebrate behavioural endpoints for regulatory ecotoxicology studies
Under current plant protection product (PPP) regulation, Tier I aquatic ecotoxicology studies measure mortality (acute) or reproduction (chronic). For invertebrates, these parameters are used to address the current protection goals of maintaining populations. Agreed guidelines for reproduction studies for aquatic invertebrates is currently not applicable due to the lack of appropriate test species. However, for some substances, other taxa/species may potentially be more sensitive e.g. Ephemeroptera, Plecoptera, Trichoptera (EPT) species. Currently, there are no agreed methods for measuring reproduction endpoints for non-standard test species, such as EPT species. EPT species often live as larvae for a prolonged period and have an aerial adult stage, and thus assessing reproductive endpoints from a full life cycle is not feasible. Therefore, if a Tier II end point (such as reproductive effects) is desirable. Although behavioural endpoints (e.g. predator response, locomotion, feeding activity) do not directly relate to the protection goals of maintaining populations, they may still have a useful role in regulatory risk assessment. For example, for organophosphates (OPs) with steep dose-response curves and thus a narrow exposure window between acute and chronic effects, significant differences on reproduction can be due to mortality of adults rather than true reproductive effects; therefore, designing specific reproduction studies for e.g. EPT species may not be necessary for such substances. Instead, if a risk assessment were undertaken using acute and behavioural endpoints and acceptable risks were concluded, then it would be unlikely for effects at the population level to arise. Here we report on our experimental Assessments (CEA) / Aquatic Ecotoxicology

TU340
The effects of sublethal doses of pollutants on crop pest, Spodoptera littoralis
D. SIAUSSAT; Institute of Ecology and Environmental Sciences / Institute of Ecology and Environmental Sciences
Pesticides have long been used as the main solution to limit agricultural pests but their widespread use resulted in chronic or diffuse environmental pollutions, development of insect resistances and biodiversity reduction. The effects of low residual doses of these chemical products on organisms that affect both targeted species (crop pests) but also beneficial insects became a major concern, particularly because low doses of pesticides can induce various effects. In addition to the negative effects, some studies highlighted unexpected positive - also called
The effect of copper nanoparticles on olfaction in rainbow trout (Oncorhynchus mykiss)

F. Borràs, University of Lethbridge / Department of Biological Sciences; E. Mohaddes, University of Lethbridge; E. Lari, G.G. Pyle, University of Lethbridge / Biological Sciences

Fish rely on olfaction for their survival, growth, and reproduction. Impairment of olfactory function can pose a threat to fish survival on the small scale and population loss on the larger scale. Metal contaminants (e.g., copper) can impair fish olfaction. Although the copper ion (Cu²⁺) has a toxic effect, whereas at least in acute toxicity, the impact of copper nanoparticles (CuNPs) on fish olfactory systems has not been well determined. The objective of this study was to investigate time-dependent effects of CuNPs and Cu²⁺ on olfactory acuity and olfactory-mediated behaviours of rainbow trout. To establish CuNPs or Cu²⁺-induced olfactory-impairment thresholds, inhibitory concentration (IC) curves were determined. Fish were exposed to a geometric dilution series of CuNPs or Cu²⁺ for 24 hours, and fish olfactory acuity was measured using electro-olfactography (EOG). Afterwards, fish were exposed to CuNPs or Cu²⁺ at concentrations known to impair olfaction by 50% (322 and 6.8 µg/L for CuNPs and Cu²⁺, respectively) for a 24 h or 96 h exposure period. The response of fish to a social cue (taurocholic acid) was studied using EOG and a choice maze behavioural assay. After the behavioural experiment, fish olfactory rosettes were dissected to investigate if there was any DNA fragmentation as a marker of apoptosis that might be induced by CuNPs or Cu²⁺. Results of EOG revealed that while a 96 h exposure to CuNPs caused a significantly greater impairment of fish olfactory function relative to a 24 h exposure to the same concentration, fish olfactory acuity partially recovered after 96 h treatment. CuNPs exposure did not trigger apoptosis in the social cue supported the results of neurophysiological experiments. Although fish exposed to control water or Cu²⁺ for 96 h had an avoidance response to an alarm cue, those exposed to the CuNPs did not respond to the alarm cue. Results of DNA fragmentation indicated apoptosis was not the mechanism of olfactory toxicity for CuNPs or Cu²⁺ in the exposed fish. In summary, over the same exposure periods, CuNPs and Cu²⁺ had a different effect on fish olfactory system and it was demonstrated that exposure to CuNPs at high concentration has no impact on fish olfactory function.

Perfluoroalkyl acids concentrations in liquid wastes: a survey campaign and impact on the toxicological profile of the chemical family of corresponding substances

M. Pascual, E. J. Fuentes, M. B. Ortiz, J. Janer, Leitat Technological Center

Perfluoroalkyl acids (PFAAs) are synthetic fluorinated compounds that are used in a wide variety of applications. They are known to be persistent and bioaccumulative. Indeed, some of them (e.g., PFOA and DecaBDE) are classified as hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents

N. Fuentes, J. Damásio, V. González-Andres, M. Díez-Ortiz, G. Janer, Leitat Technological Center

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For a more accurate characterisation of wastes and the risk of transferring PFAA pollution from production sites to disposal sites, which can be located also in no-impacted areas.

Regenerated Textile raw materials: chemical contamination for LCA

A. Branchi, Buzzi Laboratorio Analisi

It's essential, for every actor involved in the supply chain of a textile company, to increase awareness that a regenerated material requires proper and specific evaluation standards. These should ensure compliance with private protocols and mandatory laws and also permit the proper control of chemical composition.

Challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents

N. Fuentes, J. Damásio, V. González-Andres, M. Díez-Ortiz, G. Janer, Leitat Technological Center

Challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents.

Substitution of firefighting foams containing perfluoroalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents.

Andres, Ortíz, Solano, M. Pascual, E. J. Fuentes, M. B. Ortiz, J. Janer, Leitat Technological Center

Substitution of firefighting foams containing perfluoroalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents.

Informed substitution of hazardous chemicals for circular economy: science and practice

TU342

Perfluoroalkyl acids concentrations in liquid wastes: a survey campaign and implications for waste disposal

M. Pascual, E. J. Fuentes, M. B. Ortiz, J. Janer, Leitat Technological Center

A survey campaign has been carried out to determine the concentrations of twelve perfluoroalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common characteristic of these wastes was that they were classified as "wastes without dangerous substances" and could be disposed of without specific treatments. Waste samples (about 120) came from solid waste treatment plants, drinking water and isolated sewage treatment plants, landfill leachate, solid waste storage facilities, car washing, septic tanks, laundry sludge and wastes from various industrial plants such as paper, food, wood, furniture, glass and pharmaceutical industries. The large spectrum of activities allows us to get a representation of the main industries sectors and to evaluate the impact of the different sources. The percentage of samples which presented total PFAA concentrations greater than 1 µg/L was 65%. The maximum concentration measured was 900 µg/L. As regards the single congeners, the percentage of positive samples (i.e. > 0.05 µg/L) ranged from 5% to 37.5% for the different compounds. It is very interesting to note that PFOA and PFOS were found only in 5% of the samples, while the highest findings were for PFBA (57%) and PFBS (37.5%), highlighting the increasing diffusion of short chain PFAs respect to the already restricted C8-PFAAs. It is also interesting to note that one of the samples with the highest concentrations was a found in the pharmaceutical industry, and it was an aqueous washing solution of water ligors. The overall survey underlines the need for a more accurate characterisation of wastes and the risk of transferring PFAA pollution from production sites to disposal sites, which can be located also in no-impacted areas.

Substitution of firefighting foams containing per- and polyfluorinated alkyl

TU345

Substitution of firefighting foams containing perfluoroalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents.

Andres, Ortíz, Solano, M. Pascual, E. J. Fuentes, M. B. Ortiz, J. Janer, Leitat Technological Center

Substitution of firefighting foams containing perfluoroalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents.
Substances (PFASs) A. Biegel-Engler, German Environment Agency - UBA / Chemicals; L. Viecke, C. Staude, German Environment Agency / Chemicals
Per-and polyfluorinated alkyl substances (PFASs) are heat resistant and show a low friction resistance. Because of these properties PFASs are for example widely used in aqueous film forming firefighting foams (AFFF). PFASs are not degradable in the environment. Therefore, the use of AFFF into the environment causes a contamination in complex. Non chlorinated PFASs (such as PFOS and PFOA) need years to leach from top soil layers into the groundwater or into surface water. Short chain PFASs however reach ground water resources much faster due to their mobility in soil. Those contaminations already caused closed drinking water wells. Remediation is costly and long lasting. Although fluorine free foams are available and used at several European airports many firefighters hesitate to use them instead of AFFF. Restriction and authorization are regulatory measures under REACH which can be used to minimise releases of PFASs into the environment. An international regulation via the Stockholm Convention is possible as well. In addition the dialogue with stakeholders can lead to voluntary actions and may be an alternative measure to reduce environmental releases. Scientists and manufacturers need to be encouraged to develop environmentally friendly firefighting agents without fluorinated chemicals. Moreover, scientists, authorities and NGOs need to bring together knowledge about the new substances, such as analytical methods, and information on their fate and behaviour in the environment. This presentations provides an overview on regulatory actions regarding PFASs in the EU and further ideas how to substitute firefighting foams containing PFASs.

TU346 The Paradigm of Substitution - expand your view M. Zimmer, ZVO e.V.; M. Metzner, Fraunhofer Gesellschaft
Many people mention substitution as the most promising option for risk reduction in the field of SVHCs. But it has to be considered that technical solutions are embedded into complex structure-effect relationships along of equally complexity. Many different properties and outcomes have to be considered. Otherwise a thorough assessment of the applicability of an assumes alternative will fail. The surface treatment sector as a major cross-sectional community of service providers has long term experience with innovation and substitution suggested by different players for many different reasons – risk reduction being one of them. In particular the SMEs have constantly been confronted with lots of different ideas and approaches. Hence they have deep insight into unexpected side effects and regrettable outcomes. And they are able to give indicators for real promising and applicable approaches to substitution. The authors will present some significant examples of substitution attempts – and they discuss arguments why they might be considered successful - or not.

TU347 A pilot case on how Socio-Economic Evidence can inform Risk Management decision making to assess Substitution versus Recycling for non-ferrous metals slags in safe use applications H. Waertenschoot, M. vander Straaten, Euronetuxa
The implementation of the European Circular Economy policy leads to more recycling, including closing the loop on substances. This policy combined with the increasing complexity of articles leads to increasing amounts of hazardous substances and impurities being available for recycling or reuse. Recycling processes in the metals sector produce besides pure substances for safe reuse, also final slags that collect some of the impurities that cannot be recovered at economically conditioned. In parallel, the human health and environmental effects data generated by EU REACH and CLP Regulations lead to increasing hazard identifications and harmonised hazard classifications. Hazard endpoints of Very High Concern like CMR (carcinogens, mutagens and reproductive toxicity) or respiratory sensitisation may trigger substitution-based Risk Management Measures but also reduce the reuse in safe applications for “precautionary reasons”. In such cases, socio-economic evidence may be helpful to assess costs and benefits from a broader perspective, including Circular Economy and carbon footprint considerations. A pilot study conducted at a non-ferrous metal specialised in the recycling of complex end-of-life articles and materials allowed to evaluate this impact and develop a tool for assessors to check how to what extent a change in a relevant hazard classification could impact the reuse capacity of final slags. The tool allows metal companies to assess their situation in respect to Substitution (materials loss or disposal) versus Reuse in safe applications.

Developments in the ecological and human health risk assessment of biproducts: microorganisms, semiochemicals and botanicals (P)

TU348 Ecotoxicity of the hydrolate byproduct of three biproducts on the unicellular green algae Chlamydomonas reinhardtii D. Ballestero, J. Val, E. Lange, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; M. Piñeiro, Jorge University / Facultad ciencias de la salud; A.M. Mainer, Universidad de Zaragoza

Synthetic pesticides have been widely used in intensive production systems throughout most of the 20th century. However in the last decades, environmental and human health concerns demand safer substances, so research on biproducts has been increased. Although a large number of studies have been published focusing on the biological activity of biproducts on target organisms, studies regarding toxicological effects on non-target organisms, are scarce. The BIOCROP Project (Biprodectide development by chemical and biotechnological tools) has allowed the screening of several plants extracts for bio-activity against a selected set of crop pests and arthropod vectors. Some of these compounds have showed its effective value as biproducts. The extracts will be optimized by means of traditional and supercritical CO2 technologies, as well as microbiological transformations. In the extraction process the organic and the aqueous fraction (biproducts) have been separated, the former showed active compounds, being capable to act as biproducts. In order to exclude a negative effect on the environment, these products should be studied on non-target organisms. The aim of this study was to measure the acute ecotoxicity of hydrolates obtained of the semi industrial vapor-pressure essential oil extraction of three selected aromatic plant species; a domesticated Artemisia absinthium (Tuzeral, Spain), Dittrichia graveolens (Ciudad Real, Spain), and an experimentally pre-domesticated Lavandula latiheri (Toledo, Spain) using the algae Chlamydomonas reinhardtii as aquatic model organism. Results indicate that all of three extracts having biproduct activity are likely to cause toxic effects on the photosynthesis of Chlamydomonas reinhardtii, being Lavandula latiheri the most toxic compound followed by Artemisia absinthium with a very similar toxicity and Dittrichia graveolens. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolate obtained from Satureja montana (Ejea, Aragon) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydrolate of Satureja montana is likely to cause toxic effects on D. magna and V. Fischeri but only high dilutions (LC50 values in the range of 0,5% in both cases). These studies allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Burillo for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R)

TU350 The impact of the hydrolate byproduct of three biproducts on the soil environment A. Biegel-Engler, German Environment Agency - UBA / Chemicals; L. Vierke, C. Staude, German Environment Agency / Chemicals
The extended use of synthetic pesticides has resulted, during the last century, in the pollution of the agricultural soil environments. As an alternative to these products, environmentally friendly biproducts are nowadays becoming developed. Although biological activity of biproducts on target organisms is well known, studies focusing on the effects on soil non-target organisms are scarce. The BIOCROP Project (Biprodectide development by chemical and biotechnological tools) focuses on the production and optimization of plant/fungal/agriwaste-based crop protectants via cultivation techniques, biotransformation, selective extraction and separations by traditional and supercritical CO2 technologies. In the traditional extraction process the organic and the aqueous fraction (hydrolate) have been separated. Both of them showed active compounds capable to act as biproducts. In order to exclude a negative effect on the environment, these products were tested
on soil non-target organisms (microbial community and earthworms). Soil microbial communities from an ecological farming crop have been exposed to three hydrocarbons, obtained by semi-industrial vapor-pressure essential oil extraction, from three aromatic plant species: Artemisia absinthium, Ditrichia graveolens and Lavandula latifolia. The effects on the microbial community has been assessed using the community-level physiological profile – CLPP. This method relies on the ability of a microbial community for degrading different carbon sources present in BioEcolopes®. The actinotrophic hydrocarbons were also tested by Eisenia fetida bioassays. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and A. latifolia (LC50 in the range of dilution of 10-2). All three biopesticides provoked changes in the soil microbial ability to degrade different carbon sources compared to control. These results allow for a better understanding of the impacts of natural crop protectants in the soil environment as a pest management alternative. Acknowledgements: We thank J. Buriljo and J. Navarro for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R).

TU351

Acute toxicity of emulsifiable concentrate of Alpinia galangal essential oil against Cyprinus carpio

H. Kim, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University Essential oils have exhibited their fumigational and topical toxicities on insect pests and they are developed as safe biopesticides. However, their use may be caused potent toxic effects to non-target organisms in the environment. It needs to be determined their ecotoxicity effects on non-target aquatic organism. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Ricina sp. in South Korea. Acute toxicities of AGEO against Cyprinus carpio were assessed to understand its possible toxic effect on the representative aquatic organism. Cyprinus carpio in a static condition followed by OECD guideline 203 in 5 l beakers. As AGEOs were formulated for emulsifiable concentrate (EC) as an active ingredient, they were mixed with ethanol and tergitol in a ratio of 5:1. Tertitol is a surfactant and it did not show any toxic effect on the fish, so that it was used for the formulation of emulsifiable concentrate for AGEO. Three different AGEOs were prepared according to their extraction methods as steam distillation, solvent extraction and supercritical fluid extraction. After the EC formulation was prepared, they were ready to expose to C. carpio to determine LC50 values. All emulsifiable concentrates of three different AGEO showed no mortality on the tested fish during 96-hour incubation. Therefore, 48-h LC50 values for the VFE0 were under the toxicity criteria of level 3 for the pesticide to C. carpio standardized by Korea Rural Development Administration. Based on these results, AGEO can be considered to use as a natural insecticide.

TU352

Chronic toxicity of emulsifiable concentrate of cinnamon essential oils against Cyprinus carpio

H. Jeon, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University Recently, many researchers have developed natural insecticides to control insect pests by using plant essential oils (EOs) due to their eco-friendly safe properties. Cinnamon EO is one of important EOs to be a potent candidate and is formulated as an emulsifiable concentrate (EC). As its use is recognized as safe, it needs to be determined its negative effect on the environment using bioindicators. To evaluate the negative effect on the ecosystem, chronic effects of cinnamon EOEC against Cyprinus carpio was determined in a static condition for 40 days. When cinnamon EOEC was used as an active ingredient, they were mixed with ethanol and tergitol as surfactants. To select an appropriate surfactants, 8 different types of surfactants (Tween 80, Sodium dodecyl sulfate (SDS), Nonident, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Koliphor, Tergitol and Mixture of SDBS and Nonident) were tested for the formulation and tertitol showed the lowest toxicity to the fish in an acute toxicity test. With the result of the acute toxicity of cinnamon EOEC, chronic toxicities of cinnamon EOEC was determined to the 5 different concentrations for 40 days. Each concentration was triplicate exposed to 10 of C. carpio adults. The treated five concentrations were 0.08, 0.16, 0.45, 2.56, and 5.12 ppm and the mean survival rate was 4.8±4.7. The survival rate of the control group was 9.33 ± 0.58 and the positive control containing ethanol and tertitol was 8.09 ± 1.00. The mean temperature and pH of the test water was 24.06 ± 0.58°C and 7.51 ± 0.03, respectively. The mean of dissolved oxygen of the test water was 7.29 ± 0.07 mg/L and the mean of hardness was 82.14 ± 2.04 mg/L. After the complete exposure, the mean of length of alive fishes was 3.00 ± 0.17 cm and the weight was determined as 0.37 ± 0.17 g. With these results, cinnamon EOEC may be considered as safe, natural insecticides for the environment.

TU353

Thiosemicarbazone scaffold for the design of antifungal and antiflatoxigenic agents: evaluation of ligands and related metal complexes

s. menshagin, university of parma / Department of Chemistry, Life Sciences and Environmental Sustainability; f. bisceglie, d. regolino, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability; M. Study Group, University of Torino, Brescia, Pisa, Perugia and Salento / Dep of Medical and Surgical Specialties Radiological Sciences and Public Health; f. degola, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability; D. Feretti, University of Brescia Italy / Department of Medical and Surgical Specialties Radiological Science and Public Health; g. pelosi, University of Parma; m. pioli, f. restivo, m. carcelli, g. spadola, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability; C. Zani, University of Brescia Italy / Department of Medical and Surgical Specialties Radiological Science and Public Health; i. zerbini, University of Brescia / Department of Medical and Surgical Specialties, Radiological Sciences and Public Health; a. buschini, University of Parma / Department of Chemistry, Life Sciences and Environmental Sustainability

Food safety is the safeguarding and protection of food from anything harmful affecting consumer health and is an extremely important issue facing the world. Food hazards can be divided into physical, chemical and biological. Examples of biological hazard are mycotoxins, that are toxic, secondary metabolites produced by many species of filamentous fungi. Generally, mycotoxins represent a significant threat to human health as they can be carcinogenic, neurotoxic and toxic to endocrine or immune system. In particular, aflatoxins are a class of mycotoxin produced principally by two species of Aspergillus, A. flavus and A. parasiticus. Aflatoxins are found in various cereals, oil seeds, spices and nuts as a result of a fungal contamination that can occur in the field, during harvest, transport and storage. IARC has classified aflatoxins in Group 1 as carcinogenic agents to humans. The most dominant and potent aflatoxin is aflatoxin B1 and several studies indicate that high exposure to AFB1 can cause chronic toxicity and increases the incidence of hepatocellular carcinoma. A lot of methods can be applied to eliminate these toxins from food and guarantee the food safety and health concerns of the consumers. Our research aims to develop new typologies of inhibitors of Aspergillus proliferation and of aflatoxin production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosemicarbazone ligands starting from molecules of natural origin, like vanillin, perillaldehyde and their derivatives. In order to improve the biological activity, metal complexes were then synthesised. These molecules once synthesized and characterized, were initially tested to determine their antifungal and antiaflatoxigenic activity towards A. flavus. These compounds showed different efficacy in reducing fungal growth and mycotoxin accumulation. The most active compounds were used to perform cyto- and geno-toxicity tests on healthy human cells, particularly on human cell lines deriving from the districts that can be exposed to xenobiotics. Furthermore, we performed toxic and genotoxic assays on bacteria and plant cells. In conclusion, this approach allows us to study the antifungal and antiaflatoxin activity of several thiosemicarbazones and to determine the potential risk for environment and human health with a view to use these compounds in field. Financial support: Fondazione Cariplo-Project N. 2014-0555, http://aflatox.inibs.it/

Understanding human and environmental exposure to chemicals in urban systems (P)

TU354

Electronic products are related with household exposures in Canadian residences

M.L. Diamond, C. Yang, University of Toronto / Department of Earth Sciences; L. Jantunen, Environment and Climate Change Canada; D. Tsirlin, Cancer Care Ontario / Population Health and Prevention, Prevention and Cancer Control; L. Latifovic, Cancer Care Ontario; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control

Key Words: electronic products, household exposure, FRs and plasticizers

We documented levels of flame retardants (FRs) and plasticizers in paired household air and dust, hand surface wipes of Canadian women in the Canadian Community Health Survey (CCHS) wave 3.2 (2015–2016) and wave 4.2 (2017) and related these levels to participants' home and lifestyle characteristics. In wave 3.2, 2,874 participants contributed observations and participated in the study. In wave 4.2, 2,011 participants provided observations and participated in the study. Median FRs and plasticizer levels were observed in the household environment in Canada, though levels varied by region. In both waves, levels were higher in the household environment compared to personal daily household items, with the exception of PAEs and phthalates, which were highest in hand surface wipes. Levels of FRs and plasticizers were higher in house mixing areas such as kitchens and bathrooms compared to bedrooms and living rooms. We documented levels of FRs and plasticizers in paired household air and dust, hand surface wipes of Canadian women in the Canadian Community Health Survey (CCHS) wave 3.2 (2015–2016) and wave 4.2 (2017) and related these levels to participants' home and lifestyle characteristics. In wave 3.2, 2,874 participants contributed observations and participated in the study. In wave 4.2, 2,011 participants provided observations and participated in the study. Median FRs and plasticizer levels were observed in the household environment in Canada, though levels varied by region. In both waves, levels were higher in the household environment compared to personal daily household items, with the exception of PAEs and phthalates, which were highest in hand surface wipes. Levels of FRs and plasticizers were higher in house mixing areas such as kitchens and bathrooms compared to bedrooms and living rooms. Understanding human and environmental exposure to chemicals in urban systems (P)
plasticizers. Our results indicate that participants are exposed to various FRs and plasticizers through their daily household environment. The Canadian adults’ external exposure of hands to FRs and plasticizers were related to the levels in their household electronic products, particularly handheld devices such as cell phones. Handheld devices could contribute to human exposure through direct contact during use while large and stationary electronic products could be important sources and sinks in household environment.

TU355 Modelling diffuse emissions and fate of engineered nanoparticles used in outdoor paints to urban surface waters at high spatial and temporal resolution M.D. Niuèse, University of York / Environment; A. Prataetiu, University of Vigo / Department of Environmental Geosciences; A. Boxall, University of York / Environment Department

The expansion of the nanotechnology sector is leading to an increased use of products containing engineered nanoparticles (ENPs) in outdoor urban environments. Outdoor materials, such as construction materials, paints and coatings, are subject to weathering and ageing processes and will consequently lead to emissions of ENPs to the surrounding environment over time. Data on measured environmental exposure concentrations are still lacking for ENPs. Until analytical and monitoring techniques for ENPs in environmental matrices become available, modelling tools are the best approach to estimate exposure levels. Furthermore, models can analyze a wide range of potential scenarios and predict possible future trends of urban exposure which cannot be achieved by monitoring. In this study we provide a novel approach for determining ENP diffusion emissions from outdoor paints by using the dispersion modelatus, which combines an emission and a fate model for ENPs with high spatial and temporal resolution for an urban environment. The model was applied to the study of titanium dioxide (TiO2) ENP emissions when incorporated in outdoor paints in the city of York (UK). The model emission calculations are based on locally collected data on outdoor paint usage (outdoor paint application ratios and frequency of application for York) and information about the sewage network connectivity around the city. Reliable and official sources of information, such as Yorkshire Water and York City Council, and surface water characteristics acquired from an extensive and local monitoring campaign performed in the rivers Ouse and Foss, helped to parametrize the river fate model. Using the model, the transport and fate of TiO2 ENPs in the rivers circulating within the city (the Ouse and the Foss) could be studied and spatially resolved results obtained. The identification of hot spots of emissions within the city and the study of ENP transport and fate are accomplished by this approach.

TU356 Occurrence and human exposure of parabens, triclosan and triclocarban in personal care products from Korea S. Mok, Hanyang University / Marine Sciences and Convergent Technology; J. Lim, Hanyang University; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science; K. Lee, Seoul National University, Graduate School of Public Health; H. Moon, Hanyang University / Marine Sciences and Convergent Technology

Parabens (p-hydroxybenzoic acid esters), triclosan (TCS) and triclocarban (TCC), have been extensively used in various cosmetics and personal care products (CPPCs) as preservatives due to their antimicrobial activities. However, little is known about the occurrence and exposure levels of parabens, TCS and TCC associated with the consumption of CPPCs in our daily life. In this study, ten parabens and two metabolites. TCS and TCC were measured in 243 CPPCs, which comprised of leave-on products (n=157), rinse-off products (n=59) and baby care products (n=31), collected from Korean market during 2016-2017, using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Among ten parabens, methyl paraben (MeP) showed the highest detection rate (57%), followed by propyl paraben (PrP, 49%) and butyl paraben (BuP, 41%). TCS had only 20% of detection and TCC was rarely detected in the samples. Total concentration of parabens widely varied with ranging from <LOQ to 10200 µg/g. Concentrations of TCS and TCC ranged from <LOQ to 340 ng/g and <LOQ to 14.0 ng/g, respectively. Higher concentrations of parabens (> 1000 µg/g) were found at skin cares, sunscreen, face cleanser, eyeliners, body/hand lotions and lipstick. The daily exposure levels of parabens and TCS were calculated based on the consumption of CPPCs and exposure factors, obtained from questionnaire-based survey and previous studies, and concentrations measured in our study. The mean daily exposure levels of parabens were 16.2 and 0.14 µg/kg body weight/day for mothers and their infants of Korea, respectively. Among CPPCs, some leave-on products such as skin cares, body/hand lotions, and sunscreens were the major contributors (> 80%) to total exposure levels of total parabens.

TU357 Characteristics of exposure factors for consumer products in Korean infant and caregivers pair K. Lee, Seoul National University, Graduate School of Public Health; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science

Concerns about potential health risks of chemicals in consumer products like cosmetic, personal care products, food containers are growing. Especially infant and children are more vulnerable to chemical exposure compared to adults. Since exposure to these chemicals could be determined by consumer products usage pattern, an accurate measurement of the usage patterns of consumer products is important for realistic exposure assessment. The aims of this study were to determine exposure factors of consumer products for child and mother and analyze the relationship between consumer exposures of caregiver and infant. We determined the exposure factors of 12 kinds of cosmetics (3 basic cosmetics, 1 UV protection products, 3 hair products, 3 body products and 2 cleansing products) for adults and 10 kinds of consumer products (2 cosmetics, 3 oral supplies and 7 household products) for children and 11 kinds of food containers for household. Survey was conducted on 505 mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. The number of subjects were determined by proportioning based on the proportion of household, housing condition, income, parent’s education, household composition ratio in children’s sex and age distribution from 0 to 4. All cosmetics investigated in this study were used on a daily basis and usage rates from 52.1% to 98.0%, except 9.9% for hair styling product and 7.7% for deodorant. The frequency of food intake by food containers ranged 2.52 to 17.39 times a month. The use of children's oral supplies varies according to the age of the child. There were a significant difference in the mother’s usage rates of lotion, hair products and vinyl packaging food by age of children. These exposure factor characteristics could be useful input data for exposure and risk assessment for chemical regulation.

TU358 Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children N. Bravo, CSIC-IDAEA / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; B. Bocca, G. Calamandrei, A. Alimonti, Istituto Superiore di Sanità

Organophosphate (OP) and pyrethroid (PYR) pesticides are commonly used in agriculture, domestic environments and gardening. They eliminate insects because of their strong potential to disrupt the brain and nervous system of these organisms. Unfortunately, this neurotoxic effect is not selective enough as to avoid potential damage to other non-target species, including humans. OP and PYR pesticide exposure has been related to several human health effects, including respiratory, digestive, productive and neurological problems, among others. Children are more vulnerable than adults to environmental pollutant exposure because their organs and metabolism are still under development. Thus, their detoxification mechanisms are not yet mature. Once in the human body, OP and PYR pesticides are typically metabolized and excreted in urine within 4-48 hours after exposure, depending on the compound. Organophosphates are metabolized into dialkyl phosphates (DAPs) and pyrophosphate (PP), such as diethyl(methyl)phosphate (TCPY, metabolite of chlorpyrifos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarboxylic acid (MDA, metabolite of malathion), 3-chloro-4-methyl-7-hydroxycoumarin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pyrimidol (IMPY, metabolite of diazinon) and 2-dihydrilamino-6-methyl pyrimidin-4-ol (DEAMY, metabolite of pirimiphos). Concerning pyrethroids, most compounds such as permethrin, cypermethrin, deltamethrin, allethrin, resmethrin and fenvalerate are metabolized into one single compound, 3-phenoxbenzylic acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxbenzylic acid (4-F-3-PBA). Therefore, 3-PBA and 4-F-3-PBA can be used as biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using isotope dilution solid phase extraction UPLC-MS/MS. Human urine samples (n=199) from Italian children at 7 years were analyzed. Neuropsychological and psychomotor development of the children was assessed at 18-40 months by using the BAYLEY scales. In addition, neuropsychological development and intelligence were assessed at 7 years by using the NEPSY-II and the WISC, respectively. The compounds detected the most were DEAMY (98%), PNP (97%), 3-PBA (91%) and TCPY (87%). The metabolite showing the highest concentration was DEAMY with a median of 3.0 ng/mL followed by PNP, 3-PBA and TCPY with medians of 1.3, 0.56 and 0.47 ng/mL, respectively.

TU359 PAH levels in parturient and newborns from Aveiro region, Portugal M. Monteiro, Aveiro University / Biology; M. Fraga, Biology Department CESAM Aveiro University; C. Gravato, Faculdade Ciências da Universidade de Lisboa / department of Biology & CESAM; C.J. Silva, University of Aveiro / Biology Department & CESAM; A.L. Machado, University of Aveiro / CESAM

Department of Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology

Environmental exposure to humans may be critical in some residential and working areas, and therefore biomarkers can and should be used as early warning tools to depict exposure and evaluate effects. Polycyclic aromatic hydrocarbons (PAHs) are a group of priority chemicals to be studied and monitored as they are considered carcinogenic and teratogenic. In the present study we aimed to monitor human fetal exposure to PAHs by measuring concentrations of naphthalene, phenanthrene, pyrene and BaP equivalents in placenta, umbilical cord and mother’s blood (plasma and blood cells) of 49 parturient from Aveiro region, Portugal. Information organized in questionnaire forms, tissues and organs were collected following the
parturient consent. Levels of PAHs equivalents were measured by a fluorescence methodology and were correlated with exposure to tobacco smoke as well as with other information regarding mother’s lifestyle (e.g. urban or rural residential area, exposure to vehicles exhaust). In general, the studied group presented higher PAHs levels in the placenta and lower PAHs levels in the umbilical cord blood. The low molecular weight PAHs (naphthalene and phenanthrene) measured in placenta presented higher concentrations than high molecular weight PAHs (pyrene and benzo[a]pyrene). Moreover, increased levels of polycyclic naphthalene and phenanthrene equivalents were associated with exposure to vehicle exhaust, while higher levels of benzo[a]pyrene were associated with exposure to tobacco smoke at work. The highest naphthalene, pyrene and BaP equivalents levels were found in homogenized placenta of mothers who smoked in the third trimester of pregnancy. No significant differences were found between PAHs levels and anthropometrical data of newborns, but in general, higher PAHs levels were found in newborns groups with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventive medicine.

TU360 A modelling framework to link aggregate exposure pathways with internal exposures and potential bioactivity
J.A. Arnott, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; I. chestari, in used in aARC Arnot Research & Consulting; L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; X. Zhang, University of Toronto Scarborough / School of Engineering and Applied Sciences; B. Givehchi, J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences
The aggregate exposure pathway (AEP) model is a conceptual framework to help assess environmental information including (i) production, use and release, (ii) chemical fate and concentrations in various multimedia (urban and rural environments, biota), (iii) external exposures (e.g., contact rates), and (iv) internal exposures (e.g., blood concentrations) for human and ecological receptors. Some exposure models include elements of the AEP framework and are useful tools for organizing data, matching chemical concentrations throughout the exposure continuum and identifying research needs to address uncertainty in chemical evaluations. We present an overview of the Risk Assessment Identification And Ranking-Indoor and Consumer Exposure (RAIDAR-ICE) modelling framework. RAIDAR-ICE includes direct and indirect near-field exposures and can include far-field exposures for aggregate human exposure assessment. The RAIDAR-ICE model is parameterized in this case study for about 200 organic chemicals comprising a broad range of chemical properties representative of commercial chemicals to demonstrate model applications for exposure and risk-based prioritization. Based on assumed emissions to air in the indoor environment, intake fractions (used for ranking exposure potential) range from 0.0018 to 0.37 emphasising the relatively high potential for human exposures to indoor chemical emissions. The model calculated critical emission rate can be used to gauge potential risks and provide guidance for proposed new chemical use. Using in vitro bioactivity data from the ToxCast program as an assumed “effect threshold”, the critical emission rates of the case study chemicals span approximately 8 orders of magnitude. Including estimates of actual chemical use rates allows for the calculation of risk (bioactivity)-based estimates; the results of which span 10 orders of magnitude. Recommendations for addressing uncertainty in the model and its required input parameters are presented.

TU361 ENVIRONMENTAL IMPACT OF LEAD MINING ON THE BIO-ECOSYSTEM IN ISHIAGU TOWN OF EBONYI STATE IN SOUTH-EASTERN NIGERIA
S. Anika, UNIVERSITY OF NIGERIA, NSUKKA; V. Ahur, Federal University of Agriculture Makurdi / Department of Veterinary Physiology, Pharmacology and Biochemistry; P. Oneyiili, Federal University of Agriculture Makurdi / Department of Physiology Pharmacology and Biochemistry
Lead is a soft, ductile metal found naturally in the environment and accounting for 0.0016% of the earth's crust. However, due to its ubiquitous nature, it is used in several industrial processes which can result to severe environmental pollution which can pass across food chains to animals and man. In 2010, about 400 deaths especially among children in Bukkuyum and Anka LGA of Zamfara State, Nigeria, due to chronic lead toxicity were reported by Medecins Sans Frontieres (MSF, Holland) to the health authorities (UNEP, 2010). The cause of the high mortality was acute and chronic lead poisoning as a result of massive environmental contamination from artisanal mining and processing of gold in Pb-rich ore by poor headsmen and farmers. This outbreak was reported as the worst in modern history (UNEPOCHA, 2010). Open-pit mining of lead in the Ishiagu Region of Ebonyi State since 1965 has exposed large volumes of marcasites, pyrites and tailings contaminating the environment and food chain pathways. The research was designed to investigate the environmental impact of lead mining on the bio-ecosystem of Ishiagu town and environs. Soil, water, grasses/plants, food, fish and quary dust were collected between March and May 2017, processed and analyzed for lead concentrations. All water samples exceeded WHO recommended safety limits for lead. Soil and food samples contained values. Sampling of Ivo River, the main communal water source showed links to upstream pollution as the river passes through lead mining fields. The result showed the negative impact of lead mining in Ishiagu and the need for regulatory agencies/government to take measures to avert consequences of lead poisoning in human beings.

TU362 Evaluation of potential risk of rare earth element contamination from leachate originating from electronic waste disposal
M. Makome, Scientific Services, Cape Town / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Scialani, CPUT / Department of Chemistry; U. S. Hamilton, University of Western Cape / Centre for Applied Science Research; B. Givehchi, J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences
Rare Earth Elements (REEs) form critical elements required in technological accessories. Their presence in electronic waste gives leads to environmental pollution. Therefore, there is a constant necessity for accurate data and reliable fast analytical methods. This review discusses and compares the methods given for the determination of rare earth elements and heavy metals in electronic waste and other association. The main purpose was to establish the procedures used for the extraction and determination of metals in electronic waste. The methods used for REE determination in electronic waste and its disposal into the environment. Key words: Rare earth elements; electronic waste; heavy metal; extraction; spectroscopy; wastewater analysis.

TU363 A stonework snail as a new biomonitor of metal contamination in the urban environment
E. Rota, B. Braccini, R. Dei, University of Siena / Department of Physical Sciences, Earth and Environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Department of Physical Sciences, Earth and Environment; R. Bargagli, University of Siena / Department of Physical Sciences, Earth and Environment; Papillifera papillaris (O.F. Müller) is a small pulmonate gastropod commonly dwelling on stone walls and monuments in Italian and Mediterranean urban environments. This widespread, low-vagile and omnivorous organism, which barely interacts directly with soil and inhales fine particles, is a promising indicator of metal contamination and urban pollution and can be used as a tool for aggregate human exposure assessment. The RAIDAR-ICE model is parameterized in this case study for about 200 organic chemicals comprising a broad range of chemical properties representative of commercial chemicals to demonstrate model applications for exposure and risk-based prioritization. Based on assumed emissions to air in the indoor environment, intake fractions (used for ranking exposure potential) range from 0.0018 to 0.37 emphasising the relatively high potential for human exposures to indoor chemical emissions. The model calculated critical emission rate can be used to gauge potential risks and provide guidance for proposed new chemical use. Using in vitro bioactivity data from the ToxCast program as an assumed “effect threshold”, the critical emission rates of the case study chemicals span approximately 8 orders of magnitude. Including estimates of actual chemical use rates allows for the calculation of risk (bioactivity)-based estimates; the results of which span 10 orders of magnitude. Recommendations for addressing uncertainty in the model and its required input parameters are presented.

TU364 Metals Distribution in Urban Garden Soils in Greater Victoria, BC, Canada
M. Dodd, Royal Roads University / School of Environment & Sustainability
This study was conducted to determine heavy metal distribution in surface soils of urban residential and community gardens in Greater Victoria, BC, Canada Over 200 soil samples were collected from 190 residential and community gardens and analyzed using a portable XRF. A subset of the samples were analyzed by ICP-MS. A comparison of the XRF metal concentrations to the ICP-MS data indicated that the XRF was a suitable technique for the rapid analysis of the large number of samples collected. Elevated concentrations of metals including Pb, Cu, Cr and Zn, were found in some garden soils. Based on homeowner interviews, historical maps and archival reviews, Pb contamination was primarily attributed to the use of lead paints and housing maintenance practices. Potential sources of the other metal contaminants included the use of wood preservatives, septic fields, automotive
repair and old orchards. An interactive map of metal distribution based on the data obtained was developed and made available to the public. Metal bioavailability was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated EDI values were well below the respective tolerable daily intake suggesting that the risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analyzed as surrogate plants to determine potential metal uptake. Metal bioaccumulation factors and translocation factors for the dandelion samples also suggested that the potential for the uptake of the metals studied was low. However there were isolated gardens with elevated Pb concentrations which were identified as being of concern. Recommendations for limiting Pb exposure in these gardens were provided to the homeowners.

TU365 Soil quality analysis, a lever for identifying sources of trace elements and managing urban allotments for urban agriculture production
M. Lepri, A. Carabelli, V. Comastri, Unisa, University of Insubria/Aglyhe Unit
Projects seeking to produce home-consumption vegetables in urban areas and, more generally, to set up agricultural production inside cities, are increasingly numerous. Agglomerations and local public authorities also need references on thresholds of contamination in trace element and their transfer into plants. At European level, soil quality regulations are not homogeneous; in France, the legislation is mainly based on the contents in vegetables or fruits, the link with the soil never made. Some studies have highlighted the potential risk of metal contamination of vegetables grown in urban areas and the lack of site-specific risk assessments. However, experimental trials are still lacking on the potential of using urban soil as a good substrate for producing vegetables for domestic consumption. We assessed the quality of the soil on a site in the Rouen agglomeration (Normandy, France) for three purposes: pasture, a forest creation and a small market gardening area. However, the city raises questions about the future management of this last area already cultivated for many years. We have analyzed the main physicochemical characteristics of soils, the trace elements (Pb, Cu, Ni, Zn, Cd, Hg) in certain vegetables and fruits and in soils, as well as the history of agricultural practices since the sixties and the topography of the site. Transfer coefficients in consumption vegetables have also been quantified. Our results showed that the zones had a physical and chemical heterogeneity due to the effects of the different cultivation techniques used, the urbanization and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban samples was above limits, which makes gardening practices unsuitable for the area. Our results demonstrate that site-specific studies are needed before planning urban cropping areas, and educating urban gardeners about sustainable cropping techniques is a priority for safe feeding.

TU366 Vertical movement of PCBs in agricultural soils impacted by an historical contaminated site: using SoilPlus model to predict discharge, dynamics of movement in soil, and rhizoremediation potential
A. Di Guardo, University of Insubria / Department of Science and High Technology, Como; S. Armiraglio, Municipality of Brescia / Museum of Como; S. Borin, University of Insubria / Department of Science and High Technology, Como; V.M. Sale, S. Amelii, P. Nastasio, ERSAF
The aim of this study was to investigate the differences in distribution of Cd, Cu, Pb, and Zn in mobile fractions extracted from road dust samples from Belgrade, the Capital of Serbia. The metals investigated were chosen as one of the most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractioned into three sizes with diameters of: < 63 µm, 63 – 250 µm, and 250 – 500 µm. From different size fractions the metals were isolated into three fractions using a modified sequential extraction procedure after Tessier (Tessier at al., 1979): adsorptive and ion-exchangeable phase (using ammonium acetate at the moderately reduced pH of 513 kg/m3) atmospheric Pb emissions reported by industries and municipal facilities in the National Pollutant Release Inventory. This example demonstrates the importance of non-exhaust forms of traffic emissions which have not been included in emission inventories to date. Next steps will involve the collection of whole, unfractoned road dust samples from a variety of road types for particle size distribution analyses to refine elemental loadings in each size fraction.

TU368 Sequential extraction and particle size distribution of Cd, Cu, Pb and Zn in street dust of Belgrade (Serbia)
T. Djordjevic, Faculty of Chemistry, University of Belgrade; N. Zaric, Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade; T. Solevik Knudsen, ICHTM / Department for Environment
The aim of this study was to investigate the differences in distribution of Cd, Cu, Pb and Zn in mobile phases extracted from different size-fractions in street dust particles from Belgrade, the Capital of Serbia. The metals investigated were chosen as one of the most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractioned into three sizes with diameters of: < 63 µm, 63 – 250 µm, and 250 – 500 µm. From different size fractions the metals were isolated into three fractions using a modified sequential extraction procedure after Tessier (Tessier at al., 1979): adsorptive and ion-exchangeable phase (using ammonium acetate at the moderately reduced pH of 513 kg/m3) and organic sulphid phase (using hydrogen peroxide acidified with nitric acid). These fractions were analysed by inductively coupled plasma optical emission spectrometry (ICP-OES) using an ICP iCap6500 Duo-Thermo Scientific instrument. The results showed that the concentrations of the metals (based on the sum of these three fractions) were in the following order: Zn > Cu > Pb > Cd. Comparison with the Serbian national Regulations demonstrated that the concentrations of Cu and Zn in these three fractions were higher than the Maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Zn and Cu were bound mainly in the second phase. Pb and Cd were predominantly associated with the third phase and Cu was in one sample predominantly associated with the first phase. Detailed analysis of distribution of metals in different size fractions did not indicate any patterns suggesting a different origin of these metals at different locations. References: Regulations about allowed quantities of dangerous and harmful matters in soil and irrigating waters and methods about their analysis, Official gazette of Serbia, No. 23/94 (December 1994). Sequential extraction procedure for the speciation of particular trace metals. A. Tessier, P. G. C. Campbell, and M. Bisson. Analytical Chemistry, 1979, 51 (7), pp 844–851.

TU369 New "OPEs": isopropylated, tert-butylated and di-tert-butylated Tris(arylphosphate Isomers in E-waste, House, Car and NIST SRM Dust
C.L. Wiseman, University of Toronto / School of the Environment; J. Nui, C. Levesque, P.E. Rasmussen, Health Canada
Road dusts highly enriched with persistent organic pollutants such as Cu, Pb and Zn, due to road surface attrition and wear of automotive components. Despite the importance of road dust as a source of inhalable particles (< 10 µm), little has been published regarding elemental enrichment patterns in particle sizes relevant to inhalation exposures. The goal of this study is to evaluate the contribution of road dust to airborne particulate matter, focussing on metals and metalloids in the inhalable particle size range. Road dust samples were collected from a variety of street types in 2015-2016 in collaboration with the City of Toronto, representing a total road length of about 840 km. Two types of samples were generated by the regenerative-air sweepers: the bulk hopper debris and finer dust box samples. The 50th percentile particle size diameter of the dust box samples was determined by laser analysis to be 9.4 µm, which represents the inhalable fraction. A total of 64 samples (32 inhalable and 32 bulk samples) were subjected to a 4-acid digestion (HF, HClO4, HNO3 and HCl) followed by multi-element determination using Inductively-Coupled Plasma Mass Spectrometry (ICP-MS). Results showed that the inhalable fractions of road dust were enriched with metals and metalloids relative to the bulk debris, including Cd (0.55 vs. 0.25 µg/g), Zn (649 vs. 252 µg/g), Pb (8 vs. 2.2 µg/g) and Pb (80 vs. 54 µg/g). The enrichment of elements of known toxicity in the inhalable fraction is of particular concern, given the bioaccessibility of this particle size range. Available data on the total weight of road dust collected by the City of Toronto each year, combined with the elemental concentrations of the road dust determined in the present study, provides the means to calculate annual flux estimates. For example, Pb loadings in the inhalable fraction alone are estimated to range between 70 kg/yr and 141 kg/yr, which is a significant source relative to other city-wide transport contributions from market gardening, road dust, and local public facilities in the National Pollutant Release Inventory. This example demonstrates the importance of non-exhaust forms of traffic emissions which have not been included in emission inventories to date. Next steps will involve the collection of whole, unfractoned road dust samples from a variety of road types for particle size distribution analyses to refine elemental loadings in each size fraction.
Measurement of Particle Sources and Health Associations between the Southeastern United States: Contrasts in Sources and Health Associations. T. Fang, T. et al.: Oxidative Potential of Ambient Water towards dusts rich in metals and metalloids. Furthermore, the DTT assay evidenced was more sensitive to organic substances, while the AA assay showed a different sensitivity towards the oxidant species: the DTT method inorganic ions, seem thus to play a negligible role in the ROS generation. Each species whose concentration is very different in the two monitored areas, such as secondary aerosols, may affect, at least in the short term, survival and growth of snails and worms in aquatic environments. Here, conclusions are provided based on the assessment of biota toxicity and sediment accumulation factors (BSAF) values ranging between 0.67 and 1.00 for the aquatic environment. However, little is known about the bioaccumulation of sediment-associated TCS (8 µg/g dry weight (dw)) is unlikely to be detected in wristbands and metabolites in urine. These compounds are also of concern due to their potential to generate reactive oxygen species (ROS) in biological organisms, and different acellular assays are currently used in literature for its determination. In this work we applied three of the most used OP assays (dithiobis - DT), acid ascorbic acid and Leucomethylene blue: a selective photometric reagent for chlorine dioxide analysis in water. R. Devesa, Aigues de Barcelona / Chemistry. Laboratory; F. Estrany, Universitat Politècnica de Catalunya UPC; A. Garbayo, Agbar, Barcelona Water Company; X. Aldazabal, Polytechnic University of Catalonia Drinking water supply companies have traditionally focused their efforts on providing a product with health guarantees, a safe and clean water. Disinfection has been the main purpose of the water treatment. A broad range of disinfectants and technologies are available. Chlorine dioxide has been increasingly used because of its ability to avoid the formation of trihalomethanes (THMs), the most common and well-known disinfection by-products. NN-Diethyl-p-phenylenediamine (DPQ) has been without any doubt the most common procedure for the analysis of ozone and chlorine dioxide. The method easily permits the differentiation between free and combined chlorine (chloramines) and also, chlorine dioxide. While this method showed a good accuracy with real water samples (relative error below 14 % for chlorine dioxide concentrations between 0 and 1.5 mg/L). This reagent has revealed to be the best option for the determination of different compounds. The DCFH method is preferred in the laboratory for determining free and combined chlorine concentrations, due to its simplicity and sensitivity. However, little is known about the effect of the toxicity and bioaccumulation of sediment-associated TCS. We examined the effect of sediment-associated TCS on the snail, V. bellamy, and the worm, L. hoffmeisteri, and assessed worm bioaccumulation during a 28 days constant exposure period in microcosms. The DDT assay revealed a greater affinity with particles in the fine mode, while AA responded mainly to particles in the coarse fraction. DCDF results appear to be driven by a competition between several factors, some increasing the response and some suppressing it. Fang, T. et al.: Oxidative Potential of Ambient Water-Soluble PM2.5 in the Southeastern United States: Contrasts in Sources and Health Associations between Aerosol (AA) and Dithiobis (DT) Assays. Atmos. Chem. Phys. 2016, 16, 3865–79. 10.5194/acp-16-3865-2016. T. Fang et al.: Optimization of the Measurement of Particle-Bound Reactive Oxygen Species with 2,7’-dichlorofluorescin (DCFH), Water Air Soil Pollut. 2016, 227, 164.
Environmental Safety
Protection goals for the ecological risk assessment of chemicals are increasingly being framed in terms of ecosystem service delivery [1]. However, the type of data collected to assess risk is generally at the level of individual organisms or simplified multi-species systems. Currently, extrapolation from what is measured to what we want to protect uses overly simplistic approaches, such as risk quotients or toxicity-exposure-ratios. Ecological models provide a more mechanistic way of considering these disparate levels and allow for integration of other relevant information as well as feedbacks across levels of organization [2]. Here we present output from the National Institute of Mathematical and Biological Synthesis (NIMBioS) working group (www.nimbios.org/workinggroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of the mechanistic toxic effects of chemicals and other stressors from impacts on individual organisms to the delivery of ecosystem services [3]. The first case study applies an individual-based model (IBM) [4] to quantify impacts of potential endocrine disrupting chemicals on services provided by trout populations in a mountain stream in Colorado, USA. The second case study uses an aquatic ecosystem model [5] to evaluate impacts of an insecticide on multiple ecosystem services delivered by a lake ecosystem, modified to represent a reservoir in Iowa, USA. The first case study is an example where management of provision for the SCT GCP ecosystem provides will differ depending on the level of EE2 in the system. If EE2 concentrations are low, then management would need to focus on controlling BT populations. For high concentrations of EE2, management first needs to focus on reducing EE2, followed by control of BT. The second case study is an example where game fish species responded differentially to exposure to the insecticide, as a result of interspecific interactions, and the economic valuation of this service needs to take into account with angler preferences. The service of water clarity for recreational activities was valued using threshold-based estimations of days fit for recreation. We provided concrete examples of how ecological modeling can be used to quantify impacts on ecosystem services from data gathered in standard testing. We discuss challenges and ways forward.

TU378
Sulphur: conflicting protection goals
G. Brouwer, Delphy / team fruitteelt; F.M. Bakker, Eurofins-Mitos
Sulphur is a key fungicide in biological fruit production. Following a recent risk assessment, the use of sulphur in The Netherlands has been rigorously limited. Current registrations allow for two applications, which is incompatible with disease control in biological top fruit production. The regulatory decision was technically correct and based on considerations for non-target arthropods, as risk for the egg parasitoid Trichogramma could not be excluded. Under current European regulations Trichogramma is one of the sensitive indicator species selected for higher tier testing. As this is a natural enemy of several Lepidopteran pest species, the indicator is clearly linked to the specific protection goal of preserving natural pest control potential. However, in the absence of alternatives, at a broader level this specific objective frustrates the current system of biological production as a whole. The specific protection goal must clearly be balanced against the broader objective of preserving biological production. To understand the importance of egg parasitoids such as Trichogramma in Dutch orchards, the Dutch Fruit Growers Organisation have investigated the control potential of egg parasitoids in 8 orchards (4 biological, 2 conventional and 2 untreated), using parasitization rate as a functional endpoint. The investigations show that parasitization rates are extremely low (<1% of bait cards and <0.005% of the host eggs showed parasitization), suggesting a minor role of egg parasitoids in these systems in The Netherlands, at least at the time of the study (late summer 2017). Conventional orchards showed no parasitization and regular (i.e. having sulphur treatments) and untreated orchards did not show differences. These results show that specific protection goals may have country specific weight and need to be considered and balanced against potential negative impacts of eventual protective measures, such as in this case jeopardizing biological top fruit production.

The Need for Resilience in Environmental Impact Assessment (P)

TU379
Recovery in environmental risk assessments at the European Food Safety Authority (EFSA)
T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; F. Bigler, Retired; G. Frampton, University of Southampton; C. Högstrand, Kings College London / Division of Diabetes and Nutritional Sciences; R. Luttik, Retired; F. Martin, Martin-Laurent, INRA Dijon; C.J. Topping, Aarhus University / Department of Bioscience; W. Van der Werf, Wageningen University; A. Rortais, European Food Safety Authority
The European Food Safety Authority (EFSA) performs environmental risk assessments for single potential stressors such as plant protection products, genetically modified organisms and feed additives and for invasive alien species that are harmful for plant health. In 2015-2016 a Working Group of the Scientific Committee of EFSA (the authors of this abstract) explored how ecological recovery is covered under current single-stressor Environmental Risk Assessment (ERA)
schemes at EFSA and how recovery could be assessed considering the complexity of the environment. An important aim of these activities was to promote a dialogue between different panels of EFSA and risk assessors and risk managers responsible for the food and feed chains. Another important aim was to provide risk assessors with a conceptual framework to address ecological recovery in ERAs for any assessed products, and invasive alien species that are harmful for plant health. This framework proposes an integrative approach based on well-defined specific principles enabling the identification of gaps in the knowledge derived from the means of experience, modelling and monitoring, and the selection of focal taxa, communities, processes and landscapes to develop environmental scenarios to allow the assessment of recovery of organisms and ecological processes at relevant spatial and temporal scales. Due to the complexity of ecological systems and the need to evaluate effects and their impacts on communities in space and time caused by natural or human caused disasters, a systems approach is required. The systems approach allows the integration of the various species, environmental factors, scales, and stressor-related responses necessary to address the context dependency in ecological recovery. The presentation will highlight the most important conclusions, challenges and recommendations to appropriately address ecological recovery in ERA for potential stressors that fall under the remit of EFSA EFSA Scientific Committee, 2016. Recovery in environmental risk assessments at EFSA. EFSA Journal 2016; 14(2):4313, 85 pp

TU380 Habitat Equivalency Analysis for a Restoration Resilience Model of the Rio Doce Basin P.N. Booth, Ramboll Environ / Ecological Sciences; E. Singer, F. Gomes, R. Arantes, Ramboll Environ / Sao Paulo; R. Wenning, Ramboll Environ A Resilience Model was prepared to support environmental, economic, and social restoration of the Rio Doce Basin after the Fundão Dam failure in Mariana, Minas Gerais State, Brazil. A Habitat Equivalency Analysis (HEA) was applied to quantify lost ecosystem services resulting from the disaster and was intended as a method to determine restoration, the threshold required to underpin the potential for longer term habitat restoration. HEA is being refined through a process of stakeholder engagement to determine the valued environmental components (VECs); and thus the valued ecosystem services that should drive the restoration goals for each reach of the Rio Doce River. HEA is a well- accepted spatially and temporally explicit method for integrating multiple complex and difficult to measure environmental variables into a few metrics to determine overall losses and gains in ecosystem services resulting from impacts or restoration actions. The HEA method is adaptable to any ecosystem and its flexibility allows for variability in the valuation of ecosystem services between communities and cultures. This paper focuses on the development and application of HEA within the context of the Resilience Model, and how selection of VECs as indicators to guide the scale, and location of restoration is aimed at developing an overall ecosystem restoration program that is at once cost-effective and results in a more resilient Rio Doce Basin.

TU381 Using risk and recovery information in environmental cost-benefit analysis for determining appropriate risk management actions at major industrial facilities A.E. Bartram, Ramboll Environ / Product Safety, Ecology and Sediment Management; S. Deacon, Ramboll Environ & Health Limited Operators of chemical manufacturing plants and fuel storage depots are required to undertake site safety assessments, with specific emphasis on the control of major events, at sites where the potential for major accidental releases of SEVESO substances is high. The guide to environmental risk assessment drawn by the Energy Institute, Ramboll Environ developed a guide for risk assessors to determine the environmental recovery duration following major accidents of releases of SEVESO substances. Published October 2017, the guide provides a step-wise framework to identify an appropriate recovery duration based on the timing and type of events, and the resulting impacts on human and environmental assets. It includes consideration of key factors affecting recovery and the fate and effects of SEVESO III chemicals, such as PBT substances with the potential for longer-term impacts/delayed recovery. If an assessor determines that risks are intolerable, then the regulator requires facilities to consider appropriate investment in order that risks are as low as reasonably practicable. Ramboll Environ has pioneered a methodology based on ecosystem services concepts to evaluate the costs and benefits of potential risk management options. The method is used to evaluate the risk in terms of potential ‘damage avoided’ by putting risks into a socio-economic context. Case study examples will be provided where a range of infrastructure upgrade options at fuel storage depots are compared. Environmental Cost Benefit Analysis is used to determine if the upgrade would be grossly disproportionate to the risk that would provide a net benefit. The AASW includes site-specific baseline ecology, other receptors and ecosystem services provided to society. The poster will also reflect upon lessons learned by both regulators and industry in the method development. References: Energy Institute (2017). Guide to predicting environmental recovery durations from major accidents. Supporting guide to the Environmental risk tolerability for COMAH establishments guideline

TU382 Addressing Resilience in Ecosystem Services Assessment K. McDavitt, Ramboll E&H / Ecological Services; R. Wenning, Ramboll Environ / Ecology & Sediment Management; E. Bizzotto, H.R. Diogo, Ramboll / Ecological Services An ecosystem services approach to landscape and nature restoration planning and damage assessment should fully account for all aspects of the environment and the human well-being derived from protection, enhancement and repair to natural resources caused by human-caused accidents. An ecosystem services approach, conceiving of a resource as a part of an ecosystem that supplies valuable goods and services to people provides a basis for measuring changes and for valuation of those goods and services. With respect to landscape and nature restoration planning, an ecosystem services approach can lead to innovative ideas for ecological infrastructure in cities and promote ecological rehabilitation that may be ecologically and socially desirable and also economically advantageous. Resilience, however, is a key consideration that, to date, has been inadequately considered in ecosystem services assessment work. Considerations of resilience are especially important in ecosystems, because increasing resilience can reduce the risk that highly valued goods and services will cross critical thresholds and irreversibly degrade or change. Resilience also plays an important role in identifying conditions leading to the development and implementation of rational and cost-effective strategies to subsequently manage and implement regulatory obligations and financial liabilities. A customised probabilistic risk model was developed to facilitate the management of environmental and reputational risks at a portfolio of over 500 industrial sites in Spain. The sites are equipped with industrial equipment that contains large amount of oils. The equipment differs significantly in age, size, design and make, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Baleares and Canarias islands, and their environmental and social settings show a large variability. Site investigations were conducted in order to have been performed at only 5% of the sites. Initially an Environmental Risk Assessment Model was developed using technical, regulatory, social and environmental data. The compiled and consolidated data were entered into a calculation model developed in Microsoft Office Excel®. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. Oracle®’s Crystal Ball® add-on to Excel was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsoil investigation being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that may be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately-high risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventive maintenance to those sites which could give rise to the highest financial and reputational liabilities.

TU384 Quality stakeholder involvement for resilience in environmental risk
This study measures the indoor particulate matter (PM) concentrations in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM_{2.5} samples and inductively coupled plasma mass spectrometry was used to determine the concentration of heavy metals. The concentration of indoor radon was measured using a radon detector model DOSEman PRO. The potential human health damage due to the inhalation of radon is of particular concern as high radon concentrations have been reported in indoor environments, leading to an increased risk of lung cancer. The study aimed to assess the indoor radon concentration and trace metal composition in two university buildings.

TU386

SETAC Ecosystem Services Interest Group
S. E. Apitz, SEa Environmental Decisions Ltd

Air Pollution, Biomonitoring and Human Health (P)

TU387

Assessment of Indoor Radon Concentration and Trace Metals Composition in University Building Microenvironments
M. Mohd Hanafiah, Universiti Kebangsaan Malaysia; M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science; M. Khan, Universiti Kebangsaan Malaysia / Centre for Tropical Climate Change System

This study measures the indoor particulate matter (PM_{2.5}) concentration and the equilibrium equivalent radon (EEC_{Rn}) concentration in two university buildings. The study findings indicate that the indoor radon concentrations are within permissible limits suggested by the US EPA, whereas the values of equilibrium equivalent radon concentration were still below the standard recommended by ICRP.

TU388

Paradigm for PM2.5 Chemical and Biological Characterization: Paired Home and Personal PM2.5 Samples in Kheri, India
R. C. Roper, Oregon State University; Department of Environmental and Molecular Toxicology; T. L. Tanguay, Oregon State University / College of Public Health and Human Sciences; S. Simonich, Oregon State University / Dept of Chemistry and Environmental Molecular Toxicology; R. L. Tanguay, Oregon State University / Sinhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

The global public health impact from household fine particulate matter (PM_{2.5}) is extremely large, however, there is a limited understanding of health effects associated with specific PM_{2.5} chemical constituents as well as the underlying mechanisms of these adverse health effects. These research gaps can be addressed through the utilization of a high-throughput screening platform to quickly gain biological response data. A subset of homes in Kheri, India that participated in the Prospective Urban and Rural Epidemiological (PURE) study were selected to identify differences in chemical and biological measurements of household PM_{2.5}. In 6 households, personal air monitors collecting PM_{2.5} were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM_{2.5} filters for each household. PM_{2.5} was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM_{2.5} samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM_{2.5} from DMSO extraction was prepared for developmental toxicity testing performed in zebrafish (n=32/treatment) starting at 6 hours post fertilization (hpf). Aliquots of the pooled samples were used for chemical analysis (polyacrylamide hydrocarbons (PAHs, n=20), elements (n=20)) and oxidative potential assessment with methods identified in the USEPA and USEPA. Significant differences were observed in oxidative potential between personal and home PM_{2.5} for both individual and pooled samples. Significant mortality in zebrafish was observed starting at 24 hpf in personal PM_{2.5} samples and by 120 hpf in home PM_{2.5} compared to blank filter controls. Chemical analysis is underway to allow for correlations to be investigated between these biological responses and chemical constituents. This research is the first study to use paired home and personal PM_{2.5} samples with chemical, oxidative potential, and developmental toxicity data, identifying the differences in these measurements between household and personal PM_{2.5}. Importantly, it outlines procedures for large-scale analysis of the PURE-AR study which includes planned PM_{2.5} measurements in 4,000 homes and will ultimately allow for correlation of human health effects with chemical and biological data to identify improved health metrics for PM_{2.5} exposures.

TU389

Toxicity of airborne particulate matter as a factor to choose the most convenient school
F. Sánchez Schöber, Universitat Rovira i Virgili / Chemical Engineering; N. Serra, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health; V. Linares, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health; M. Bellés, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health; M. Schuhmacher, Rovira i Virgili University / Department d’Enginyeria Química

One of the critical decisions parents have to face is choosing a good school for their kids. Proximity, high ratio of teachers to students, and access to convenient educational infrastructures are the driving factors determining school’s choice. However, it was shown that environmental air inside schools is safe enough.
Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 µm; also referred as “fine PM”) is considered as the most injurious one. Since this pollutant is potentially very harmful, toxicity of PM$_{2.5}$ on lung cells has been widely studied. However, most of the publications on this topic are focused on studying PM$_{2.5}$ effects on human alveolar cells for short periods of time after applying doses far higher than environmental levels. To surpass this gap, we have conducted a present study. On it, we collected two fractions of fine PM (PM$_{2.5,10}$ and PM$_{2.5,12}$) in two classrooms of a school located using the impactor (SKC) of 12 schools during two seasons (winter and summer). Consequently, concentrations of the different chemical constituents of particles are variable, although indoor particles trend to have higher shares of carbonaceous materials. Our results will be useful not only to schools managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.

TU390
Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Visits

Y. Lan, C. Chang, C. Chung, China Medical University

Abstract: The purpose of this study was to assess the effects of extremely high air temperatures on hospital emergency room visits (ER) related to alcohol addiction and other mental illnesses in Taiwan. A time series study was conducted using health and climatic data from 2000 to 2010 in Taiwan. A national health insurance database, temperature database, and air quality surveillance database were used for this study. Relative risks (RRs) for increases in emergency room (ER) visits were estimated for alcohol addiction and other mental illnesses after exposure to extremely hot temperatures (99% percentile) and the 50th percentile of the daily mean temperature as reference. Poisson regression models using a distributed lag non-linear model (DLNM) were used. We adjusted for the effects of humidity and outdoor air pollutants. We found an association between alcohol addiction and other mental illnesses and mean daily temperature at 23.6°F on ER visits. The association was strongest within 0–7 days after exposure to hot temperatures. Increases (RR 1.02, 95% CI 1.01–1.04) in major depressive disorder (MDD) ER visits was observed over a cumulative period of 7 days after exposure to high ambient temperature (99th percentile vs. 50th percentile). The opposite association was reported for alcohol addiction (RR 0.99, 95% CI 0.98–0.99). No significant associations with anxiety, dementia, and delirium were estimated. Our findings suggest that extreme temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU391
Characteristics of Polybrominated Diphenyl Ethers Released from Primitive E-Waste Treatment

T. Li, J. Liu, Jinan University; J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University School of Environment

Abstract: Primitive processing of e-waste potentially releases abundant organic contaminants to the environment, but the magnitudes and mechanisms remain to be adequately addressed. The present study conducted thermal treatment and open burning of typical e-wastes, i.e., plastics and printed circuit boards. Emission factors of the smoke and dioxins formed from polybrominated diphenyl ethers (BDEs) were estimated by the updraft method. Trapeze cascade impactor, SKC) of 12 schools during two seasons (winter and summer). Consequently, concentrations of the different chemical constituents of particles are variable, although indoor particles trend to have higher shares of carbonaceous materials. Our results will be useful not only to schools managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.

TU392
How risky is the schoolyard? An approach from chemical composition of particulate matter

F. Kadar, J. Sienna, Universitat Rovira i Virgili; H. Chem Election Engineering; J. Rovira, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Química

According to last estimations, there are globally around 6.5 million deaths as a consequence of exposure to air pollutants. Among them, Particulate Matter (PM) is considered as the most harmful one. This material consists on solid particles and liquid droplets suspended in the atmosphere having a diameter smaller than 10 µm. Since they can come from a wide array of different sources (i.e. traffic, industries, indoor dust) their physicochemical characteristics are very heterogeneous, and knowing them becomes important in order to assess its damaging potential. To improve the knowledge regarding physicochemical characteristics of PM that children are exposed in schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). These three fractions of PM were collected in the schoolyard (high volume samplers Tisch 670-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer). Therefore, the objective of the present study was to evaluate the children’s exposure to different sizes of PM. To do so, three fractions of PM (smaller than 10, 2.5, and 1 µm) were collected in the playground and inside a classroom of 12 schools within the Tarragona county (Spain), an area characterized by having one of the most prominent industrial clusters in southern Europe. To elucidate time-activity patterns of kids, and to know the characteristics of their dwellings, questionnaires were delivered to parents of kids attending these schools. Using an infiltration model (IAQX, US EPA) it was possible to calculate concentrations of PM inside houses. A subsequent run of a dosimetry model (MPPD2.11, ARAD) made possible to know the deposition pattern of the different PM sizes within the distinct parts of the respiratory tract.

TU393
Good news to lazybones kids: increasing sleeping time decreases exposure to airborne particulate matter

F. Sánchez Sobrón, Universitat Rovira i Virgili / Chemical Engineering; F. Noaño, Universitat Rovira i Virgili / Department of Chemical Engineering; M. Marín, Universitat Rovira i Virgili / Department of Chemical Engineering

Abstract: In this study, we have performed a longitudinal analysis of the concentration of fine particulate matter (PM$_{2.5}$) in the breath of children living in schools of three different environments: urban, petrochemical, and chemical. Subsequently, we exposed human alveolar epithelial cells (A549) to IC$_{50}$ doses obtained from a previous study. Then, apoptosis and release of 17 cytokines from the cells was studied after five different exposure times: 0, 6, 24, 48, and 72 hours. Preliminary results showed no differences in cytokines release among the two PM sizes or three sampling sites. However, differences appeared when comparing the levels of seven cytokines (MCP-1, TNF-α, INF-γ, G-CSF, IL-6, IL-7, and IL-8) versus exposure times. These differences became significant after 24–48 h from exposure, and increased till reaching the maximum value after 72 hours. Results from this study will be useful not only to better understand the way of action of PM$_{2.5}$, but also to schools managers and parents.

TU394
Occupational Cement Dust Exposure: effect on blood level of some antioxidant enzymes and vitamins in Owerri, Nigeria

C. Ikaraoha, J.A. Eugene, Imo State University Owerri, Imo State, Nigeria / Chemical Pathology Unit Dept of Medical Laboratory Science; C. Unadhik, Imo State University Owerri, Imo State, Nigeria / Medical Laboratory Science; N.C. Mbadiwe, University of Nigeria Teaching Hospital, Enugu, Nigeria / Medicine; J. Dike-Ndum, Imo State University Owerri / Department of Medical Laboratory Science

ABSTRACT: Despite that cement dust with particulate matters are hazardous to humans, yet occupational cement dust exposure continues among Cement workers. Cement is a mixture of cement with cement dust particles. Their toxicological effects are due to the type and level of chemicals in the dust. Zinc and lead levels of some antioxidant enzymes and vitamins have not been adequately addressed especially in a black-African environment and particularly Nigeria. By random sampling method, 35 Cement workers, 35 Cement Dealers and 35 controls were selected for this study. Blood antioxidant enzyme such as glutathione peroxidase, superoxide dismutase (SOD) and catalase (CAT) were determined using ELISA while antioxidant vitamins such as vitamin E and vitamin C were determined by Spectrophotometric techniques. There were progressive significant increases in blood level of vitamin C, vitamin E, catalase and glutathione peroxidase from Cement Workers to Dealers and Controls (non-cement workers), (P=0.0010, P=0.0011,
reached the steady state within 10 days. None of significant difference in load membrane were examined. Results have shown that the bioaccessibilities of particulate organic contaminants using simulated human lung Environment xie c farming management steps can have a positive effect in NH d. Ammonia is an atmospheric pollutant causing acidification of soil, nutrient-N enrichment of ecosystems, and eutrophication of terrestrial and aquatic ecosystems. When in gaseous form, NH has a short atmospheric lifetime and usually deposits near its source. In the atmosphere it reacts with other compounds to form ammonium sulfate and ammonium nitrate aerosols, leading to the formation of secondary inorganic aerosol (PM$_{2.5}$) that are a potential health hazard. Due to their smaller diameter and increased atmospheric lifetime, these particulates are able to travel long distances before being dry or wet deposited to the ground surface. This allows them to travel from rural areas to urban locations where they mix and build up in the atmosphere leading to smog or transportation to other areas. The particular unfavorable meteorological and orographic conditions of the Po Valley make this one of the most polluted regions of Europe. Particulate matter pollution often exceeds the EU standards and WHO air quality guidelines for health protection. Because a main source of ammonia emissions, the agro-zoo-technical compartment plays a key role in the secondary PM formation. Indeed, secondary inorganic aerosol from NH$_3$ accounts for 40% of PM$_{2.5}$ mass at the urban sites, and its contribution is even bigger in the rural sites. This study aims at evaluating the environmental performance of different NH$_3$ mitigation strategies applied to Italian pig farms. Different mitigation scenarios are compared, considering the application of manure treatments. In this study, available Technologies Reference document for the Intensive Rearing of Poultry and Pigs. Different strategies can be applied to determine the effectiveness of mitigation options: the SHERPAP model or other approaches like Life Cycle Assessment can indicate the environmental benefits achievable with the different scenarios analyzed. Although techniques may be implemented and managed separately, they produce synergistic effect on the farm's emission inventories. The total integrated life cycle of NH$_3$ from pig farming will lead to a higher amount of nitrogen in the manure and to the amount that potentially be emitted to air as NH during the downstream process of manure storage and spreading. The reduction of NH$_3$ emission from pig farming management steps can have a positive effect in NH$_3$-related impact categories, such as PM formation, terrestrial acidicification and eutrophication.

Development of an In Vitro Method to evaluate the Inhalation Bioaccessibility of Particle-Bound Hydrophobic Organic Chemicals and its Effects of Particle Size S. Li, J. Jinan University; L. Bao, E.Y. Zeng. Jinan University / School of Environment Bioaccessibility of particle-bound hydrophobic organic contaminants and its effects of particle size are significant for assessing the potential human health risk via inhalation exposure, but have not been clearly evaluated. To fill this knowledge gap, the present study develops an in vitro method to estimate the inhalation bioaccessibility of hydrophobic organic compounds using lung fluids, i.e., artificial lysosomal fluid (ALF) and Gamble’s solution amended by dipalmityl-sn-glycero-3-phosphocholine, with Tenax as the absorption sink. Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds and the assay parameters such as incubation time and the influence of particulate load membrane were examined. Results have shown that the bioaccessibilities of individual PAH compounds increased with the increasing incubation time and reached the steady state within 10 days. None of significant difference was found for the individual PAH bioaccessibilities between with and without adding glass microfiber membrane into the incubation system. Furthermore, the PAHs absolute recoveries, calculated by sum of PAHs masses in Tenax, artificial lung fluid, and residual particle dividing the initial masses, were from 92% to 112% in ALF and 75% to 99% in Gamble’s solution, suggesting that this developed in vitro method could be well appropriate to evaluate the inhalation bioaccessibility to particulate hydrophobic organics matter. In addition, the PAHs bioaccessibility were found to increase with particle size, but decrease with the increasing hydrophobicity. It is noteworthy that via the human respiratory tract, the inhalation bioaccessibility of particle-bound PAHs was reduced by more than 90% if the size-dependent PAHs bioaccessibility and deposition efficiency were involved into the assessment.

Toxicity does not vanish into thin air - molecular mechanisms of air pollutant mixture toxicity Z. Novakova, Masaryk University; J. Novak, Masaryk University / RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Kukccka, P. Pribylova, R. Prokes, Masaryk University / RECETOX; G. Lammel, Max Planck Institute for Chemistry / Multiphase Chemistry Department Air pollution remains to be a hot environmental issue in many regions worldwide. It can directly affect human health and can contribute to higher incidence of pulmonary and cardiovascular diseases or cancer. Moreover, it has been shown that compounds occurring in the ambient air pose a hazard to disrupt our endocrine, immune or reproductive system. Since the air pollutants occur in complex mixtures, it is more appropriate to use an effect-based monitoring including a battery of in vitro bioassays which cover various interactions among mixture constituents. Bioassays represent an efficient approach for toxicological profiling and identification of pollutant modes of action. Together with chemicals analyses, they enable to identify main toxicity drivers. Two sites were selected, a heavily polluted urban site (industries, transportation, coal-based domestic heating) and a regional background. Samples were collected in summer and winter. To assess the more specific contribution of the different components of the PM$_{10}$ coarse particulate phase, and six PM$_{2.5}$ size-fractions were sampled. Moreover, samples were also fractionated according to polarity. Human-based in vitro bioassays were employed to study endocrine-disruptive potentials, AhR-mediated induction of detoxification mechanisms, and cytogenotoxicity to the human respiratory tract. The results show that the studied effects were associated mainly with particulate phase. The most significant effects were attributed to the easily inhalable fine and ultratine particles. This distribution pattern was found for example for AhR-mediated toxicity, estrogenicity, and androgenicity. The studied toxic potentials were elicited mainly by chemicals in the polar fraction containing relatively high levels of oxygenated-polymeric aromatic hydrocarbons (oxy-PAHs). This study confirms that several molecular mechanisms of toxicity link in many regions worldwide. The results will be discussed together with the results of the chemical analysis which focused on PAHs and their derivatives, nitro- and oxy-PAHs. This research was supported by project GACR 503 16-11537S.

Human health assessment of air pollution exposure to tuberculosis risk in regions of Taiwan H. Lin, National Taiwan University; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; Y. Yang, C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; C. Liao, National Taiwan University / Bioenvironmental Systems Engineering; H. Lin Human health risk assessment;Air pollution;Tuberculosis;Population attributable fraction;Probabilistic risk assessment
PM2.5 can be a more important factor for determining PM2.5 toxicity than mass concentration, but recent research gained considerable attention as a major air pollutant in recent years. Recently, it is

Accessing the Asian supply chain structure of health impacts with PM2.5

PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-tumorigenic bronchial epithelium BEAS-2B cells as model of the respiratory tract. Effects on cell proliferation and cytotoxicity were assessed daily by the MTS assay and the evaluation of DNA-release from damaged cells. Sub lethal responses were also measured including oxidative stress, DNA damage, mitochondrial membrane potential and metabolic alterations. In order to evaluate the ecotoxicological effects on seedlings growth and root damages, cress seeds were exposed to standard soil contaminated with non-airborne particles. The innovative cementitious pads were comparable to traditional pads in terms of braking performance but showed significantly reduced airborne particles production. Results showed different toxicity between particles generated from traditional and innovative braking systems: in our experimental models, particles derived from cementitious pads were less toxic than those from the resin based pads.

TU400
Toxic oxidation transformation products of phenanthrene measured in laboratory generated secondary organic aerosol particles

A. Karaman, D. Baderna, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; S. Gemma, L. Brunelli, F. Teodoli, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; A. Bonfanti, Brembo S.p.A.; E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

The protection and improvement of air quality are key critical points of environmental public health policies, and in particular for respiratory and cardiovascular diseases. Inhalation of contaminated air and airborne particles is definitely the main route of exposure to the most important pollutants, secondary only to the diet. Several respiratory and cardiovascular diseases are associated with air pollution. Air pollution is responsible for 400,000 deaths per year in EU28. In 2013 outdoor air pollution was classified as carcinogenic to man (Group 1) by the International Agency for Research on Cancer, with a special attention to airborne dusts. In addition, powders can alter aquatic and terrestrial ecosystems when they reach the surface waters and soils as a result of transport and deposition events. Road transport and traffic contributes greatly to emissions of PM2.5 and PM10 and an important contribution to the non-exhaustive emission is due to the wear of brakes. The European Life+ COBRA (LIFE13 ENV/IT000492) project aims to create a safer alternative to the pads currently on the market, replacing the frictional bonds with a new cementitious hydraulic binder. The study here presented evaluated the eco-and toxicological potential of particulate matters generated in laboratory conditions using test benches capable of simulating vehicle braking cycles. PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-tumorigenic bronchial epithelium BEAS-2B cells as model of the respiratory tract. Effects on cell proliferation and cytotoxicity were assessed daily by the MTS assay and the evaluation of DNA-release from damaged cells. Sub lethal responses were also measured including oxidative stress, DNA damage, mitochondrial membrane potential and metabolic alterations. In order to evaluate the ecotoxicological effects on seedlings growth and root damages, cress seeds were exposed to standard soil contaminated with non-airborne particles. The innovative cementitious pads were comparable to traditional pads in terms of braking performance but showed significantly reduced airborne particles production. Results showed different toxicity between particles generated from traditional and innovative braking systems: in our experimental models, particles derived from cementitious pads were less toxic than those from the resin based pads.

TU402
Source apportionment study of PM10 and PM2.5 using selective wind direction sampling technique in the area of Civitavecchia (Italy)

M. Nocchi, G. Settimo, G. Gagliardi, Istituto Superiore di Sanità / Environment and Health; G. Settimo, M. Inglessis, Istituto Superiore di Sanità / Department of Environment and Health; g. marsili, osservatorio ambientale; m. soggiu, Istituto Superiore di Sanità / Department of Environment and Health

Developmental toxicity will assessed by evaluating morphological changes, and their attribution to specific sources through the source apportionment methodologies is an important research topic in air quality study; in fact, the possibility to discriminate between different emission sources and between natural and anthropogenic contribution is a key issue for planning efficient air pollution reduction and mitigation strategies. Moreover, the knowledge of the chemical composition of PM for the different size fractions is recognized as increasingly important, in particular with respect to health effects of exposed population. The aim of the study is the characterization of PM10 and PM2.5 main sources located in the Civitavecchia harbour-industrial area (Central Italy), namely a large coal-fired power plant, a natural gas power plant, the harbour area, the vehicular traffic (due to both the local traffic and the highway crossing the area) and small industrial activities located in the town. To this purpose, the approach based on the use of PM samplers coupled with a wind-select sensor, allowing a selective PM10 and PM2.5 sampling downwind to specific emission sources, has been used. Furthermore, the chemical characterization of the PM collected has been carried out in order to explain specific emission patterns, and to assess the concentration levels of the micro-pollutants emitted by local sources and particularly toxic for health. Two sampling sites have been identified in the area, respectively urban and urban background site, and equipped with a PM10 and PM2.5 wind-select sampling device, designed to collect airflows from two directions, downwind respectively the coal-fired power plant and the port area. Samples of PM10 and PM2.5 were monthly collected for one year, and chemical analyses were performed to determine the concentrations of organic and inorganic species. The reductive statistical analysis of data was performed, also verifying the occurrence of legislative threshold exceedances. Moreover, in order to highlight the contribution of specific sources, the differences in the measured micro pollutants concentrations between wind directions, PM size fractions and sampling sites have been investigated, as well as the seasonal trends of pollutants concentrations. These results allow to highlight that the applied methodology represents a valid support in source apportionment studies. Keywords: source apportionment, wind select-sampling device, PM10, PM2.5

TU403
Forecasting global atmospheric visibility based on air quality and meteorological data

H. Xiao, NUEORS, Chinese Academy of Sciences / NUEORS; J. Zhang, L. Tong, H. Yi, M. He, J. Zheng, IUE, Chinese Academy of Sciences

Simultaneous and continuous measurements of visibility, meteorological parameters, including relative humidity, and the concentrations of six atmospheric pollutants (PM2.5, PM10, SO2, NO2, CO, and O3) were obtained for several cites around the globe. The characteristics of visibility and relationships with air pollutants and meteorological factors were investigated using multiple statistical methods. Analysis demonstrated that within a certain relative humidity range, visibility is the exponential function of the PM10 concentration. Thus, non-linear models combining multiple linear regressions with exponential regression were subsequently developed to describe the hygroscopic growth and the attenuation effects of the air pollutants. The accuracy of the derived models can quantitatively describe the relationships between visibility, air quality and meteorological parameters around the whole globe.

TU404
Analyzing the Asian supply chain structure of health impacts with PM2.5

F. Nagashima, Kyushu University; K. Nansai, National Institute for Environmental Studies; S. Chatani, National Institute of Environmental Studies; S. Kagawa, Kyushu University

The concentrations of airborne particulate matter (PM) in the area, respectively urban and urban background site, and equipped with a PM10 and PM2.5 wind-select sampling device, designed to collect airflows from two directions, downwind respectively the coal-fired power plant and the port area. Samples of PM10 and PM2.5 were monthly collected for one year, and chemical analyses were performed to determine the concentrations of organic and inorganic species. The reductive statistical analysis of data was performed, also verifying the occurrence of legislative threshold exceedances. Moreover, in order to highlight the contribution of specific sources, the differences in the measured micro pollutants concentrations between wind directions, PM size fractions and sampling sites have been investigated, as well as the seasonal trends of pollutants concentrations. These results allow to highlight that the applied methodology represents a valid support in source apportionment studies. Keywords: source apportionment, wind select-sampling device, PM10, PM2.5
Countries and regions in Asia have played an important role in producing intermediate products and final commodities today and supplied their products around the world. Productions and consumptions of goods and services in the Asian countries have clearly contributed to the economic growth in the world, whereas those economic activities brought about environmental loads. Particularly, China’s emissions of air pollutants such as fine particulate matter (PM$_2.5$) have caused serious environmental and public health problems. To better understand the environmental and health impacts associated with the PM$_2.5$ through the Asian supply chains have been estimated in the previous research. While these analyses showed what production activities induced these health hazards caused by “primary” PM$_2.5$, almost of these results doesn’t include the effects of “secondary” PM$_2.5$. This study developed the secondary PM$_2.5$ concentrations emitted on every industry sector using Emission Sources Database for Global Atmospheric Research (EDGAR) emission inventory data, Weather Research and Forecasting (WRF) model and CMAQ modeling system, and then estimates the induced mortality data in Asia. We further applied structural path analysis (SPA) to the Asian International Input-Output Table (AIIOIT) to clarify the critical supply chains for the reduction of health impacts in Asia. The result shows that the Japan’s consumption contribution to secondary PM$_2.5$ emissions in Asian were estimated 155 Tg, and we revealed top ranking supply-chain paths for PM$_2.5$ emissions induced by Japan’s final demand. The most significant supply-chain path with the highest emissions was the path from transportation sector in China to Japan’s final demand, and subsequently the path, other food products sector in Thailand —> food crops sector in Thailand —> Japan’s final demand. We also argued the health impacts caused by the trans-boundary pollutions in Asian countries.

TU405 Source contributions to PM10 levels in a coastal area in northern France: a one year study

F. Le Goater, S. Roche, M. Borgie, L. Mouflarre, University of Littoral Côte d’Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492; G. Delmaire, University of Littoral Côte d’Opale / Laboratoire Informaticque Signal de la Côte d’Opale LISIS EA4491; G. Roussel, M. Puigt, University of Littoral Côte d’Opale / Laboratoire Informatique Signal Image de la Côte d’Opale LISIS EA4491; C. Beaugaud, ATMO Hauts-de-France; D. Dewaele, P. Genevray, University of Littoral Côte d’Opale / Laboratoire Informatique Signal Image de la Côte d’Opale LISIS EA4491; C. Lazard, H. Vouhé, INERIS; D. Courcou, Université du Littoral Côte d’Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492

The Hauts-de-France Region is one of the most concerned areas in France by exceedances of the PM$_{10}$ daily mean limit value (50 µg.m$^{-3}$). For a better understanding of these phenomena, the identification as exhaustive as possible of source contributions to secondary PM$_{10}$ emissions in Asnières was estimated 1158 Tg, and we revealed top ranking supply-chain paths for PM$_{10}$ emissions induced by Japan’s final demand. The most significant supply-chain path with the highest emissions was the path from transportation sector in China to Japan’s final demand, and subsequently the path, other food products sector in Thailand —> food crops sector in Thailand —> Japan’s final demand. We also argued the health impacts caused by the trans-boundary pollutions in Asian countries.

TU406 Source-to-exposure assessment of industrial pollutants in Australia, using the Pangea multi-scale framework

C. Wannaz, The University of Michigan, Ann Arbor / SPHEHS; P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division; D. Lane, University of Queensland, Brisbane; O. Jolliet, University of Michigan

Effective planning of airshed pollution mitigation is often constrained by a lack of integrative analysis ability to relate the relevant emitters to the receptor populations at risk. Both emitter and receptor perspectives are therefore needed to consistently inform emission and exposure reduction measures. This presentation aims to extend the Pangea spatial multi-scale multimedia framework to evaluate source-to-receptor relationships of industrial sources of organic pollutants in Australia. Pangea solves a large compartmental system in parallel by block to determine arrays of masses at steady-state for 100,000+ compartments and 4,000+ receptor locations, and further computes population health exposure by inhalation and ingestion. From an environmental perspective, spatial distribution of population exposure shows high spatial variations in intake fractions from 0.68 to 33 ppm for benzo(a)pyrene, and from 0.006 to 9.5 ppm for formaldehyde, contrasting urban, rural, desert, and sea emission source locations. Extending analyses to the receptor perspective, population exposures from the combined emissions of 4,101 sources were performed for both longer and shorter distances, versus formaldehyde that has a more local impact. Decomposing exposure per industrial sector shows petrochemical and steel industry as the highest contributing industrial sectors for benzo(a)pyrene, whereas the electricity sector and petroleum refining contribute most to formaldehyde exposures. The source apportionment identifies the main sources contributing to exposure at five locations of interest. Overall, this presentation demonstrates the relevance of addressing exposures both from an emitter perspective well-suited to inform product oriented approaches such as LCA, and from a receptor perspective for health risk mitigation. <br clear="all"/>

TU407 Non-targeted screening of DNA adducts as biomarkers for human exposure to PAHs in the environment with liquid chromatography tandem mass spectrometry

Y. Feng, C. Yao, Health Canada; W. Foster, McMaster University

Humans are constantly exposed to thousands of contaminants in the environment. Polycyclic aromatic hydrocarbons (PAHs) are a group of organic compounds containing two or more aromatic rings. They are released into the environment from both natural and anthropogenic sources such as combustion of organic substances and incomplete burning of coal, oil, gasoline, tobacco products and wood. PAHs are known to be bio-transformed by phase I metabolic enzymes to chemically reactive intermediates that may bind covalently to DNA to form DNA adducts that interfere with DNA synthesis and transcription, leading to DNA mutations and/or toxic effects. Furthermore, binding of electrophilic PAH metabolites to DNA is thought to be a key step in the initiation of cancer. Therefore, measurement of those DNA adducts could be an indicator or biomarker of human exposure to PAHs in the environment and of the dose of the ultimate reactive metabolite. Rapid non-targeted approaches are desired to explore a broader scope of new biomarkers associated with the contaminants of interest. Non-targeted approaches are non-time consuming and do not rely on the prior knowledge of adducts. In this presentation, we will report a non-targeted screening method for identification of covalent DNA adducts using a combination of neutral loss scan and product ion scan in a Q-Trap system. The method was applied to non-targeted screening of DNA adducts in follicular cells isolated from ovarian follicles that were exposed to cigarette smoke condensate (CSC). Four DNA adducts, benzo[a]pyrene-7,8-dihydriodiol-9,10-epoxide-dG(BPDE-dG), phenanthrene-1,2-quinone-dG(PhqQ-dG), BaP(7,8-quinone-dG (BPQ-dG) and 4-amino-biphenyl-dG, were identified in the follicular cells. The results also revealed that two oxidative biomarkers, 8-hydroxydeoxyguanosine (8-OH-dG) and 8-isoprostane (8-Isop), had strong correlations with the three DNA adducts, BPDE-dG, BPQ-dG and PhqQ-dG, suggesting a strong link between them, that formation of covalent DNA adducts and DNA damaging oxidative stress. The method has also been successful applied to investigate the selectivity of chemicals to modify the nitrogenous bases on DNA sequence. The results showed that each chemical had a different selectivity when it modified the DNA bases. The method has been demonstrated to be a potential tool to provide screening of unknown DNA adducts as biomarkers of human exposure to the parent contaminants in the environment.

TU408 Global inter-comparison of polycrylate foam passive air samplers evaluating variability due to sampler design and analysis

L. Reuter, M. van der Zee; University of Twente / RECETOX Research Centre for Toxic Compounds in the Environment; P. Bohlin Nizzetto, NILU - Norwegian Institute for Air Research / MILK; T. Harner, Environnement Canada / Air Quality Research Division; J. Klanova, Masaryk University / RECETOX Research Centre for Toxic Compounds in the Environment; O. Armand-Munoz, Universidad Nacional Autonoma de Mexico / Centro de Ciencias de la Atmósfera; B. Aristizabal Zuluaga, Universidad Nacional de Colombia Sede Manizales / Hydraulic Engineering and Environmental Research Group; M.Y. Tominaga, CETESB Companhia Ambiental do Estado de Sao Paulo; A.J. Sweetman, Lancaster University / Lancaster Environment Centre; B. Jimenez, IQOG-CSIC / Department of Instrumental Analysis and Environmental Chemistry; A. Dreyer, Eurofins GFA GmbH; M. Odabasi, Dokuz Eylul University; J. He, University of Nottingham Ningbo; W. Ma, Harbin Institute of Technology / China/International Joint Research Center for Persistent Toxic Substances (URC-PTS); J. Ma, Lanzhou University / College of Earth and Environmental Sciences; G. Zhang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences / State Key Laboratory of Organic spatial multimedia framework to evaluate source-to-receptor relationships of industrial sources of organic pollutants in Australia. Pangea solves a large compartmental system in parallel by block to determine arrays of masses at steady-state for 100,000+ compartments and 4,000+ receptor locations, and further computes population health exposure by inhalation and ingestion. From an environmental perspective, spatial distribution of population exposure shows high spatial variations in intake fractions from 0.68 to 33 ppm for benzo(a)pyrene, and from 0.006 to 9.5 ppm for formaldehyde, contrasting urban, rural, desert, and sea emission source locations. Extending analyses to the receptor perspective, population exposures from the combined emissions of 4,101 sources were performed for both longer and shorter distances, versus formaldehyde that has a more local impact. Decomposing exposure per industrial sector shows petrochemical and steel industry as the highest contributing industrial sectors for benzo(a)pyrene, whereas the electricity sector and petroleum refining contribute most to formaldehyde exposures. The source apportionment identifies the main sources contributing to exposure at five locations of interest. Overall, this presentation demonstrates the relevance of addressing exposures both from an emitter perspective well-suited to inform product oriented approaches such as LCA, and from a receptor perspective for health risk mitigation. <br clear="all"/>
Geochemistry; J. Mueller, C. Paxman, X. Wang, The University of Queensland / Queensland Alliance for Environmental Health Sciences
Polyurethane foam passive air sampler (PUF-PAS) are the most commonly used passive air sampler for a range of semivolatile organic compounds (SVOCs) such as regulated persistent organic pollutants and polycyclic aromatic hydrocarbons, and emerging SVOCs (e.g. novel flame retardants, phthalates, current-use pesticides). PUF-PAS are used in global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use similar double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for spatio-temporal trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of PUF-PAS samplers from around the world and deployed them in a multi-part inter-comparison in order to evaluate the variability in reported concentrations introduced by different elements of PAS monitoring. Three sets of PUF-PAS were deployed in Kjeller, Norway in 2015-2016, as follows: (1) 3-month deployment of 15 PAS provided by international research groups, and returned to their respective research groups for analysis for SVOCs – this provides information on the overall variability in global monitoring data introduced by differences in sampler configurations and analytical methods; (2) 3-month deployment of 15 identical PAS, which were then distributed to international laboratories for SVOC analysis, to isolate the influence of analytical variability; and (3) 3-month deployment of 15 different PAS and analysis at a single laboratory (RECETOX Trace Analytical Laboratories, Masaryk University) to isolate the influence of PAS design on data comparability. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

TU409 Microplastic Indoor Air Pollution Using a Simulated Breathing Mannequin - µFT-IR Imaginary Quantities
N. van Alst, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; R.L. Jensen, Aalborg University; J. Vollertsen, Aalborg University / Civil Engineering Department
Extensive research has been performed on indoor air quality (IAQ) over the last decades. This includes in situ breathing mechanisms of deposition in indoor air, and on surfaces, as well as determining particle types and sizes. However, microplastic research in indoor air has been lagging behind. With the strides in microplastic research in the last years renewed interest has now arisen on microplastics as a form of indoor air pollution. This research focusses on microplastics in indoor air, with emphasis on the potential exposure to humans as a result of inhalation. This is simulated using a mannequin setup built to imitate the breathing apparatus. The mannequin takes air in through the mouth, which is led through a copper pipe to the filtering unit. The copper pipe meets a filter holder on which a 0.8 µm custom-cut 20 mm SteriTech silver membrane filter appropriate for µFT-IR imaging analysis is mounted. This is connected to a dual piston pump which simulates natural breathing. Samples have been taken in actively lived in apartments, as well as various locations within the universities’ work environment. Samples have been divided up into continuous sampling and intermittent sampling under active living/working conditions. All samples have received active sampling for approximately 24h, either using continuous or intermittent collection. In each environment a catalogue and accompanying material for spectral identification is kept of the interior. The aim of the research is to ascertain the contribution of materials from the indoor environment as a function of activity, and determine possible exposures as well as contamination levels coming from indoor air. For identification and quantification of microplastics contained in the samples, an Agilent Technologies micro-Fourier Transform Infrared (µFT-IR) imaging system equipped with a 128 x 128 Mercury Cadmium Telluride (MCT) detector. The samples are rinsed into acetone on the silver filter at 3.3 or 5.5 µm pixel resolution, providing microplastic detection down to 6-10 µm in particle size. After collection, data is exported to in-house developed software for obtaining polymeric composition and quantifying size and mass of all µFT-IR imaged microplastics. Analysis of samples is ongoing and scheduled to be completed by March 2018.

TU410 Composite electrospun fibers based on sustainable and biodegradable polymers for monitoring air pollution
A. Mucagazzoni, E. Zampetti, N. Pirrone, CNR-Institute of Atmospheric Pollution Research; G. Scarsascia Mugnozza, University of Tuscia-DBAF; C. D Natale, R. Paolosse, University of Tor Vergata; F. De Cesarì, University of Tuscia-DBAF
Environmental monitoring is a growing concern in both developed and non-developed countries. Air quality monitoring is usually performed with specialized equipment and analytical methods by regulatory agencies and researchers. However EU projects guidelines report the need to involve also citizens in environmental monitoring, thus low-cost and easy-to-use technologies are required. To achieve this aim, novel sensors for environmental monitoring have been designed and developed to date to obtain reliable values comparable to those provided by standard methods and technologies. Currently, electrospinning is considered as one of the most versatile and inexpensive manufacturing technologies to fabricate sensors and develop new materials based on polymeric and/or volatile organic compounds (VOCs) in the air. Sensors based on polymeric fibers look extremely attractive for the low cost and great versatility of the raw materials that can be easily tunable, according to the transducer used and the application of interest, taking part to the resulting sensing features (selectivity and sensitivity). Therefore electrospun nanofibrous and environmentally friendly materials have been designed and fabricated for detecting a range of pollutants and VOCs. This presentation has been focused on the challenging goal of obtaining conductive sensors for the monitoring of air pollutants employing suitable scaffolds of eco-friendly (polyhydroxybutyrate) and sustainable (recycled) nanomaterials (polystyrene). Indeed biodegradability is a noteworthy feature to obtain sensing tools environmentally friendly and safe for health. However, sensors for gas monitoring must also be able to both persist intact for a useful shelf life and to preserve their sensing features over time, depending on the specific application and the working period. Finally, the selectivity of fibers can be tuned by introducing differently functionalized macromolecules (Me-tetraphenylporphins) that are sensitive to several classes of gas and VOCs. The conductivity of the planned sensors has been implemented by adding conductive nanoparticles (e.g. graphene’s flakes). Rapid response, reproducibility and stability have been achieved as well. Conductive sensors were tested to detect nitrogen oxides and ammonia in traces and VOCs, mainly due to both high porosity and high surface of interaction. Therefore, the use of polymers obtainable from recycled and biodegradable plastics sounds to be a promising and alternative strategy for the development of smart scaffolding for air pollution monitoring. Keywords: advanced sensors, sustainable and biodegradable polymers, nanofibers, air pollution.

TU411 Determination of Cross Component Concentration Gradient of Polycyclic Aromatic Hydrocarbons using PE Passive Samplers
L. Titaley, J. Westwood, University of Manchester / Centre for Applied Geosciences; C. Zarfi, University of Tuebingen / Center for Applied Geoscience
Several polycyclic aromatic hydrocarbons (PAHs) are considered as human carcinogens or toxic to reproduction, and are thus a relevant class of “substances of very high concern” according to the European Chemicals Legislation REACH. Emerging Place of PAHs (EPA) passive samplers have been used to develop sensors to detect gases and volatile organic compounds (VOCs) such as polycyclic aromatic hydrocarbons (PAHs). PAHs are the most commonly used passive air samplers for a range of semivolatile organic compounds (SVOCs) such as polycyclic aromatic hydrocarbons, and emerging SVOCs (e.g. novel flame retardants, phthalates, current-use pesticides). PUF-PAS are used in global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use similar double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for spatio-temporal trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of PUF-PAS samplers from around the world and deployed them in a multi-part inter-comparison in order to evaluate the variability in reported concentrations introduced by different elements of PAS monitoring. Three sets of PUF-PAS were deployed in Kjeller, Norway in 2015-2016, as follows: (1) 3-month deployment of 15 PAS provided by international research groups, and returned to their respective research groups for analysis for SVOCs – this provides information on the overall variability in global monitoring data introduced by differences in sampler configurations and analytical methods; (2) 3-month deployment of 15 identical PAS, which were then distributed to international laboratories for SVOC analysis, to isolate the influence of analytical variability; and (3) 3-month deployment of 15 different PAS and analysis at a single laboratory (RECETOX Trace Analytical Laboratories, Masaryk University) to isolate the influence of PAS design on data comparability. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

TU412 Evaluating Computational and Structural Approaches to Predict Transformation Products of Atmospheric Polycyclic Aromatic Hydrocarbons
J. Titaley, L. Westwood, Centre for Applied Geosciences; E. Zampetti, University of Manchester / Centre for Applied Geosciences; D.M. Walden, M. Ogba, Oregon State University / Department of Chemistry; P.H. Cheong, Oregon State University / Department of Chemistry; S. Simonich, Oregon State University / Department of Chemistry; J. Meierdierks, University of Tubingen / Center for Applied Geosciences; C. Zarfi, University of Tuebingen / Center for Applied Geoscience
The determination of the actual flux direction of PAHs across the soil-atmosphere interface is critical to understanding the fate of PAHs in the environment and has major implications for human health. The partitioning of PAHs across the soil-atmosphere interface is led through a copper pipe or double film diffusion model, was applied to the experimental data in order to depict homogenous profiles, considering Phe as representative PAH concentration gradients of the 16 EPA PAHs at this interface as well as the respective flux direction. Atmospheric monitorings have been conducted seasonally for two subsequent years using 80 µm thick PE sheets at three rural sites. During the second year an additional height has been implemented as well as active sampling. Soil samples were taken at each location at several intervals up to 50 cm depth and equipped with in situ with 30 µm thick PE sheets. A numerical approach, based on the double film diffusion model, was applied to the experimental data in order to deduce the atmospheric concentration over time. Seasonal deployments illustrate significant variations with 10 fold higher PAH concentrations in the atmosphere during winter compared to summer monitoring. Concentrations within the soil depicted homogeneous profiles, considering Phe as representative PAH concentrations in the soil were in the range of 100 ng/g PE after equilibration. In contrast concentrations on the PE in the atmosphere vary between 70 ng/g during summer and 1200 ng/g during winter monitoring. This explicit difference between soil and atmosphere during colder months indicates a main flux direction into the soil.
Kekulé resonance structures, 2) thermodynamic stability of all possible OH-PAH adduct intermediate, 3) electron density at each carbon on the PAH and 4) average local ionization energy (ALIE) at atom or bond sites. To evaluate the accuracy of these approaches, the predicted PAH-TPs were compared to published laboratory observations of major PAHs, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clar’s resonance structures were able to best predict the lone double ring of the PAHs, but did not offer insights in terms of which carbon is most reactive. All other computational approaches provided specificity in their predictions, yet the ALIE approach was the most superior in accuracy, when compared to laboratory data. The high predictive capability of ALIE shows great potential for the prediction of the formation of previously unstudied PAH-TPs that are likely to form in the atmosphere. Furthermore, the results show that the environmental chemists to prioritize which PAH-TPs might be formed in the environment; the organic chemists to prioritize which PAH-TPs should be synthesized to verify their presence in the environment; and the toxicologists to prioritize which PAH-TPs should be analyzed for their toxicity and potential human health implications. Future direction of the study is to expand the prediction to screen for PAH-TPs from other parent-PAHs as well as alkylated-PAHs.

TU413
Spatial distribution of gas-phase Polycyclic Aromatic Hydrocarbons along South America and Antarctica
A. Arevelo, Instituto Federal do Rio Grande do Sul; K.S. Miglioranza, University of Concepcion; I. Almeida, Universidade de Sao Paulo; P.G. Costa, FURG / Escola de quimica e alimentos; R. Barra, Universidade de Concepcion; O.P. Amarante Jr, IFMA / DAQ; F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences; G. Filman, Universidade Federal do Rio Grande FURG / Instituto de Quimica; F. Rios, Universidade Federal de Santa Catarina / Instituto de Ecotoxicologia e Contaminacao Ambiental, Instituto de Investigaciones Marinas y Costeras; A. Hopke, Washington State University / Department of Atmospheric Sciences.

Polycyclic Aromatic Hydrocarbons (PAHs) are a large group of compounds with two or more condensed aromatic rings. These compounds are emitted from various sources to the atmosphere and some of them are known by their carcinogenic or mutagenic properties. However, qualitative information is limited about PAHs in air, and normally rely on the availability of active sampling techniques, usually expensive and laborious, needing power source, inexistence in remote areas. Conversely, passive sampling allows cheap and easy handling atmospheric appraisal even in remote regions. Thus, the present study evaluated PAHs levels throughout the South American atmosphere employing XAD2-based passive atmospheric sampling (PAS). The Latin American Atmospheric Sampling Network (LAPAN) has been in 2010 by deploying a pair of PAS containing one cartridge of XAD2-2 resin on each site. Resins were deployed for 12 months during 3 consecutive years at 42 sites (16 sites in Brazil and 26 distributed in Argentina, Chile, Peru, Uruguay, Venezuela and Antarctica) covering different backgrounds (rural, urban / industrial and remote). Passive samplers and XAD2 resin were prepared as described by Wania et al. (2003). XAD-2 resins were extracted by hexane/dichloromethane (1:1), purified and analyzed by gas chromatography/mass spectrometry (GC/MS) and/or by HPLC. The results revealed the presence of low molecular weight PAHs than inhalation. Air, food, and cotton clothing samples were analyzed for 16 PAHs. Based on the occurrence of atmospheric PAHs, dermal absorption of low molecular-weight PAHs was greater than inhalation intake. In addition, the net excreted amounts of OH-naphthalene, OH-fluorene, OH-phenanthrene, and OH-pyrene via dermal contact were 397, 63, 98, and 28 ng respectively, comparable to those via combined dermal inhalation and exposure, which were 453, 98, 126, and 38 ng. The ratios of excretion to intake via dermal contact were 0.11, 0.036, and 0.043 for fluorene, phenanthrene, and pyrene, respectively, higher than those for inhalation (0.097, 0.016, and 0.025). These results indicate that dermal absorption is a significant exposure route of PAHs. In the case of BBQ fumes, dermal absorption is a more important pathway for intake of low molecular-weight PAHs than inhalation.

TU415
EDS Mapping of Particles As A Component of Lichen Biomonitoring in Seattle, Washington
G.T. Guddal, Western Washington University; J. Miller, A. Johnson, Western Washington University / Environmental Sciences Department; R. Sofield, Western Washington University

Lichen are an increasingly popular medium for conducting air quality monitoring due to their sensitivity to SO2 and NOx, as well as their biocrusts related of airborne material. This study incorporates characterization of particulate matter (PM) on the surface of lichen Ramalina farinacea to map exposure to air pollution in three industrial clusters in Seattle, Washington, USA. The PM was characterized using scanning electron microscope with energy-dispersive X-ray spectroscopy mapping to determine PM size and composition. We also measured biomonitoring of certain metals in the lichen and the biomarkers glutathione, chlorophyll degradation, malondialdehyde, and usnic acid. Principal components analysis has identified which geographic locations and particle types correlate the strongest with increased metal accumulation and physiological response in the lichen.

TU416
TBARS in horse hair as an indicator of oil industry pollution
M. Kovačević, Department of Biology, University of Osijek; T. Plavac, B. Kutuzović Hackenberger, University of Osijek / Department of Biology

Air pollution is a major problem today. Although there are many tests that measure the presence of certain substances in the air, it is important to measure the impact of various pollutants on living organisms as well. Horses that spend time outdoors are exposed to environmental influences, and some of them are measurable in horse hair. The aim of this study is to assess how pollutants of the oil industry affect biological markers in permanent horse hair from mane and tail and whether the concentration of thiobarbituric acid reactive substances (TBARS) can be used as biomarker of oil industry air pollution. The horse hair samples from man and tail were collected from two areas. One near Slavonski Brod, where an issue of air pollution is present due the outdated refinery plant in Bosanski Brod, and the other near Osijek where no apparent air industry pollution is present. The concentration of TBARS in samples was measured fluorometrically. The samples were cut into segments to detect differences in duration of exposure through the age of hair. The concentration of TBARS was significantly higher in the hair exposed to polluted air (Slavonski Brod site). When segments were analysed according to the age of hair it was noticed a constant difference in concentration of TBARS between roots and top for mane and tail. A significant correlation between age of hair and concentration of TBARS was noticed. Although further research is needed, a concentration of TBARS in horse hair could serve as a simple and inexpensive method for monitoring air pollution by oil industry.

TU417
Morbidity for environment-related diseases in La Spezia, northwest Italy: an epidemiological analysis on hospital discharge rates.
F. Lucamore, University Rome Tor Vergata / Department of Biomedicine and Prevention; A. Petersburg, A. Pietruzzi, University Rome Tor Vergata / Department of Medical Biometry and Prevention; N. Toschi, University Rome Tor Vergata; A. Duggento, University of Rome Tor Vergata / Department of Biomedicine and Prevention; C. Alessandroni, C. Ambrosone, L. Palombi, University Rome Tor Vergata

Background. La Spezia Province, northwest Italy, is a potentially high risk area because of the massive presence of industrial and harbor activities. Only controversial evidence of their health impact in the area is available at the moment. Therefore, a comprehensive survey on potentially environment-related disease would be really useful. Methods. Liguria Region hospital discharge records from 2001 to 2013 have been collected. Only admissions for cardiovascular disease, respiratory disease or neoplasms as primary diagnosis were included. Hospital discharge rates, standardized by age and compared with Regional mean, were represented using geographic maps with a color scale identifying different disease distribution. For those disorders showing significant difference with regional mean, disease distribution was compared with emissions of air pollutants, estimated by Lichens biomonitoring. Results. La Spezia Province Hospital Discharge rates for potentially environment-related disease significantly differed if compared with those of the Liguria Region. Malignant melanoma, chronic bronchitis and myocardial infarction rates were higher both in men and women (with a percentage increase of 84% and 87%, respectively, for malignant melanoma; +22% and +47% for chronic bronchitis and +40% and +41% for myocardial infarction). Conversely, hospital discharge rates for diabetes and hypertensive cardiopathy were lower than those of the Liguria Region: -50% among males and -49% among women for the first and -56% and -54%, respectively, for the second. Comparing these results with Lichens maps, no evidence of a clear correlation between emissions of air pollutants and regional distribution of diseases was available. On the contrary, diseases differing the most
from Regional mean were mainly distributed in areas with scarce anthropic activity. **Conclusions.** No clear morbidity trend is identifiable for La Spezia Province from 2001 to 2013. Also disorders belonging to the same pathological class – like myocardial infarction and hypertensive cardiopathy – showed a different behavior. Comparing results with Lichen maps helps put excesses of morbidity into a Regional context, being cautious to clearly correlate such disease with industrial and Harbour activity. Indeed, most of the disorders showed the higher increases in areas with less signs of anthropic activity, according to Lichens biomonitoring.

**TU418 Risk Assessment of Polyethylene Residues and Organoleptic Attributes of Bambara nut pudding (Okpa) Samples prepared using Alternative Cooking Materials**

T. Otitoju, University of Nigeria Nsukka / human nutrition and dietetics; O. Otitoju, federal University Wukari / Department of Biochemistry; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; S. Baiyeri, Federal University OyeEkiti / Agronomy

Polyethylene residues are chemical components that are left over as monomers and end products after the thermal degradation of polyethylene. However, the use of plastic as cooking materials in bambara nut pudding (Okpa) a well-cherished food, especially among the inhabitants of the Eastern part of Nigeria may pose more danger than envisaged. The use of banana leaves in cooking food has been in existence in Nigeria before the introduction of the technological cooking materials such as polyethylene, cellophane plastic, tin and foil. In this study, we evaluated the risk assessment of polyethylene residues (volatile organic compounds - VOCs) and organoleptic attributes of Bambara nut pudding (Okpa) samples prepared using alternative cooking materials. Purge and trap method using Gas Chromatography and Mass Spectrometry instrument were used to estimate the concentrations of VOCs in the different pudding cooked using some alternative cooking material (cellophane, tin, foil and plastic) while banana leaves were used as control. Organoleptic evaluation was done using A-Point Hedonic Scale, standard methods and ANOVA was used to compare means of the results. The result showed the presence of some Volatile Organic Compounds such as Argon, Allene, Acetic acid, Propane-1-ol, difluoromethane, Hexanoic acid, Amyl nitrite, Toluene, Butenininitrile, 2-Butenal, Thirane, Nonanoic acid, Ethylenediamine, Furfural, Hydrogen azide, 2-pentene, Formic acid, and acetic acid; with Acetic acid occurring the most and Argon, Allene, and Difluoromethane occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannohexulose, 45% hexanoic acid, 25% propane-1- ethenylthio and had other VOCs ranging from 4-9%. All the cooking materials had hexanoic acid at high concentrations of 25-42%. The result also showed that acetic acid and 2-butenenitrile ranged from 4-7% in all samples except Banana leaves pudding. Organoleptic evaluation of the Bambara pudding samples with different alternative cooking materials were generally acceptable (p>0.05) but pudding wrapped with banana leaf was significantly (p<0.05) rated low for colour and taste while others were comparable (p>0.05). In conclusion, bambara nut pudding cooked with alternative cooking materials contained polyethylene residues.

**TU419 SETAC Human Health Risk Assessment Interest Group**

B. Mulearn, Ensafe Inc.

**Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (P)**

**TU420 Ecological risk assessment of conazole fungicides in arable soils of the Czech Republic**

J. Vesickova, M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); P. Kousbova, Central Institute for Supervising and Testing in Agriculture; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); Z. Simek, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); Z. Budzinski, Univ. Tulln); Z. Simek, Masaryk University / Faculty of Science, RECETOX; J. Vasil’kova, Central Institute for Environmental Research Centre for Toxic Compounds in the Environment (RECETOX); P. Kosubova, Central Institute for Environmental Research Centre for Toxic Compounds in the Environment (RECETOX); J. Vasickova

In vineyards of South West France, fungicides account for nearly 8 out of 10 pesticides used. Fungicides such as cyprodinil, kresoxim-methyl, tebuconazole, difenoconazole (23%), prochloraz (21%), propiconazole (13%), cyproconazole (8%) and epoxiconazole (48%) of soils) and tebuconazole (36%), followed by flusilazole (23%), prochloraz (21%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CFs fungicides are of environmental concern because they exceeded risk based thresholds, tend to form long-term residues in soil and rank among suspected carcinogens and endocrine disruptors. [1] EU pesticide database - europa.eu/food/pesticides/eu-pesticidesdatabase [2] M. Hvezdova, et al., Sci. Total. Environ., vol. 613–614, pp. 361–370, 2018.

**TU421 Concentration- and time-dependent dissipation, partitioning and plant accumulation of selected fungicides, insecticide, herbicide and transformation products in sand and soil**

N. Neuwirthová, Masaryk University; Z. Bílková, Masaryk University / RECETOX; J. Vasil’kova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Breška, Masaryk University / Faculty of Science RECETOX

In this study, the dissipation and partitioning dynamics and the extent of biotransformation were measured and modeled for selected hazardous current-used fungicides (prochloraz, tebuconazole, flusilazole, epoxiconazole), insecticide (chloropyrifos), herbicide (pendimethalin) and for a transformation product (2-hydroxyatrazine) in agricultural soil and quartz sand as representatives of a real and a worst-case scenario. Dissipation, uptake to Lactuca sativa and the freely dissolved compounds along with the ethenylthio and had other particulate matter were determined on day 12, 40, and 90 following the application of compounds at three fortification levels (0.1 - 1.0 - 10 mg/kg). Dissipation of tested compounds differed in soil and sand and was influenced by compound concentration. 2-hydroxyatrazine showed the longest persistence in soil among the tested compounds. The four fungicides showed very similar dissipation patterns and were more persistent in sand than in soil which implies that their main elimination mechanism in the environment is biodegradation. Plant roots were shown to accumulate higher amounts than shoots with root-to-shoot translocation factors (TFs) of 0.007-0.14 where the extent of root uptake was driven bypartitioning. This was evidenced by the ability of C_{soil} to reliably (r = 0.94) predict root uptake. Concentrations in shoots did not exceed the maximum residue levels (MRLs) for lettuce. Kc values were in the range of literature values and were shown to increase (from day 0 to day 40) as well as decreased for some compounds (from day 40 to day 90) with time probably as a result of compound sequestration and competitive sorption, respectively. From the results, it follows that the tested compounds posed limited risks when presented in the soils for a given time but it is shown to be not persistent (except for 2-hydroxyatrazine), b) to accumulate in lettuce to extents below MRLs, c) to sorb effectively to soil, even in the presence of other co-solutes.

**TU422 Evaluation of pesticides and fungicides transport using passive sampling devices in a vineyard catchment in South West France**

J. Gaillard, Université de Bordeaux / EPOC UMR 5805; M. Dèviet, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS, K. Le Menach, P. Pardon, UMR CNRS EPOC Université Bordeaux / UMR 5805; G. DUPORTE, Université de Bordeaux / EPOC UMR 5805; F. Macary, Irstea Bordeaux; H. Budzinska, University of Bordeaux.

In vineyards of South West France, fungicides account for nearly 8 out of 10 pesticide applications which increases the likelihood of chronic exposure in adjacent ecosystems. The objective of the present study was to investigate the dynamics of pesticides and fungicides from agricultural drainage ditches to a third order stream in a vineyard catchment. Monitoring was a combination of passive and grab water sampling. Six sites with continuous-flowing monitoring were equipped with an automatic sampler for at least two months. Two of the sites also included grab water sampling. Passive samplers such as POCIS enable the improvement of limits of quantification (LOQ) and estimation of time-weighted average concentrations over the exposure period. Passive sampling was compared to the results of the same study performed in vineyards of South West France. Pesticide residues were targeted including 23 fungicides currently applied in the studied catchment. Extracted samples were analysed by liquid chromatography-tandem mass spectrometry (LC-MS/MS) and gas chromatography-tandem mass spectrometry (GC-MS/MS). Among the currently used pesticides in the catchment, preliminary results obtained from a sampling campaign conducted in spring allowed the quantification of 19 fungicides, 3 herbicides and 1 insecticide in passive samplers. In water samples, 9 fungicides and 1 insecticide were detected. Highest concentrations (>1 µg/g) were measured for the fungicides benalaxyl and demetomorph. Fungicides such as cyprodinil, kresoxim-methyl and iprolaricarb.
were detected in passive samplers but were not detected in water samples suggesting the importance of combined sampling techniques to provide a more complete assessment of fungicide exposure in vineyard catchments.

TU423
Assessment of secondary exposure to fungicide residues in fruit-growing workers who were exposed to chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), in a mouse model to evaluate a causal association with death

Y. Park, GLP Center, Catholic University of Daegu / APT; H. Kim, Graduate School of Medical Health Science, Catholic University of Daegu; B. Kang, Catholic University of Daegu, Graduate school of toxicology assessment

The deaths of Korean victims whose exposure was confirmed in several apple-holding counties, south-west of France. Dislodgeable foliar residues (DFR) and pesticide residues on equipments or apples (wibe sampling) were used to study the different activities of apple growing (treatments, re-entry tasks, harvests). Atmospheric levels of pesticides (outdoor and indoor) were also determined using passive samplers (Polysurethane Foams, PUF) and low-volume sampling (in the car). The study was mainly focused on two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry (LC-TOF-TOF-MS and HPLC-ESI-MS/MS). Levels of pesticide residues and source characterisation will be presented. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

TU424
Intra-trachael administration of the disinfectant, chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), in a mouse model

G. Duporthe, J. Gaillard, Université de Bordeaux / EPOC UMR 5805; E. Barron, University of Bordeaux, CNRS / EPOC UMR 5805; K. Le Menach, P. Pardon, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; I. Baldi, University of Bordeaux / ISPEP, EPICEEN; F. Macary, Inreta Bordeaux; M. Devier, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; H. Budzinski, University of Bordeaux.

European Union countries have about 12 million agricultural holdings, and approximately 172 million hectares (39% of the total European land surface) of agricultural areas. Pesticides are used extensively in agricultural production to prevent pests, diseases, weeds or other plant pathogens to reduce yield losses and to guarantee a good harvest. In the recent decades, numerous studies have suggested adverse health effects associated to long-term pesticide exposure.2 Serious health concerns have been raised about health risks resulting from occupational exposure.

Nevertheless, the knowledge of occupational exposure levels and determinants to pesticides are still limited. The CANEPA project (Cancers and Exposures to Agricultural Pesticides) aims to characterise external contamination of agricultural workers and environmental contamination by pesticides in arboriculture. In this work, assessed the deaths of Korean victims whose exposure was confirmed in several apple-holding counties, south-west of France. Dislodgeable foliar residues (DFR) and pesticide residues on equipments or apples (wibe sampling) were used to study the different activities of apple growing (treatments, re-entry tasks, harvests). Atmospheric levels of pesticides (outdoor and indoor) were also determined using passive samplers (Polysurethane Foams, PUF) and low-volume sampling (in the car). The study was mainly focused on two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry (LC-TOF-TOF-MS and HPLC-ESI-MS/MS). Levels of pesticide residues and source characterisation will be presented. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

TU426
Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826): laboratory and field investigations

T. Campani, I. Caliani, C. Pozzuoli, L. Poggioni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Cassini, University of Siena / Science E. The cells were cultured in a minimal essential medium supplemented with 10% fetal bovine serum (v/v), penicillin (100 U ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment. with 5% CO2 (v/v), at 37°C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein degradation in Petri dishes (7.5×10^6 cells) and for genotoxicity parameters in microplates. From the MITT assays, the LC50 was determined (29.88 (25.9 to 34.37) μg/mL Iprodione). The activity of SOD decreased significantly 40% (p < 0.05) to 25 μg/ml of Iprodione, while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased 30% (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces tripolar and micronuclear divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alteration in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.

TU427
Potential Salinity Enhanced Impacts of the Phototoxicity of the Fungicides to Inland Silversidews, Menidia beryllina


The use of fungicides represents one of the most important factors in the control of pests and diseases, which affects the production systems of fruits and vegetables. It is known that most fungicide residues remain stable in food for long periods of time, increasing exposure risk for the general population. The aim of the present study was to evaluate the oxidative damage, the antioxidant response and the genotoxic effect in a human cell line (HeP-2) against the exposure of sublethal concentrations of the fungicide Iprodione. For this proposal, we determine the content of protein carbonyls as a marker of oxidative damage, the equivalent content of glutathione (GSH), the activity of antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) and from detoxifying enzyme GSH-S-transferase (GST), in 3 concentrations of Iprodione (1.5, 7 and 25 μg/ml). The cell division index, the replication index, the frequency of chromosomal aberrations and micronuclei were also determined in the presence of 7.5; 17.5 and 25 μg/ml of Iprodione. The LC50 was determined (29.88 (25.9 to 34.37) μg/mL Iprodione). The activity of SOD decreased significantly 40% (p < 0.05) to 25 μg/ml of Iprodione, while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased 30% (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces tripolar and micronuclear divisions at 17.5 and 25 μg/ml and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alteration in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.
E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

Dicloran and chlorothalonil are two active ingredients in fungicides commonly used in the United States that readily undergo photolysis in the presence of sunlight. Both pesticides have been reported to half-live in seawater and freshwater. While the rate of degradation and losses of dicloran is impacted by the seawater (7.5 hours), the distribution of intermediate products is altered significantly; 2-chloro-1,4-benzoquinone forms at nearly double the concentration in seawater as opposed to freshwater. Chlorothalonil quickly degrades to 4-hydroxychlorothalonil via soil degradation and hydroxyclohexothalonil can desorb back into the water column where it can be photochemically degraded. The degradation rate and half-life of hydroxylchlorothalonil is very short, but differs significantly between freshwater (32.5 min.) and seawater (301 min.). Both dicloran and hydroxyclohexothalonil have similar proposed photodegradation pathways, therefore the potential for enhanced phototoxicity due to salinity variation is possible. Dicloran has shown to be phototoxic to invertebrates at concentrations as low as 0.10 mg/L, with >90% mortality at 0.75 mg/L. Adverse sub-lethal impacts have also been observed, such as an upregulation in the CCL28 and PTGS2 genes. The effects of salinity on chemical toxicity may warrant changes to future chemical assessments.

TU428
From mother to offspring: multigenerational effects of carbendazim at individual and subcellular levels in Daphnia magna
A.R. Silva, University of Aveiro / Dept.of Biology & CESAM; C.S. Santos, Ghent University (UGent) / Terrestrial Ecology Unit (TEREC) - Department of Biology; N.G. Ferreira, Aveiro University CESAM / Departamento de Biologia and CESAM; R. Morgado, University of Aveiro / Department of Biology and CESAM; D. Nunes Cardoso, CESAM, University of Aveiro / department of Biology & CESAM; A. Cruz, University of Aveiro; S. Mendo, A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology

Anthropogenic activities such as the use of pesticides may have indirect disastrous effects of carbendazim, which has a high potential to end up in aquatic ecosystems mainly through runoff. The deleterious effects observed at the population level can often be depicted or explained by changes in homeostasis at cellular and individual levels. In the present study, an isocalon population of Daphnia magna (clone k6) was exposed to an environmentally relevant concentration (5 μg/L) of carbendazim during two generations. The effects of carbendazim on survival, growth, reproduction, parental length, DNA damage (determined by comet assay), biochemical biomarkers (cholesterinase, catalase and glutathione S-transferase), lipid peroxidation and energy-related parameters (carbohydrates, lipids and proteins jointly with energy available and energy consumption) were assessed in some generations. The long-term exposure to carbendazim presented no effect on the intrinsic rate of natural increase (r) and length of adult D. magna. However, daphnids longevity decreased at F12 generation and an increase in DNA damage from generation F3 to F13 was found when compared to daphnids in clean medium. Cholineserases and glutathione S-transferase activities and lipid peroxidation showed differences between non-exposed and exposed populations to carbendazim. However, for catalase and energy-related parameters (except lipids) no differences were observed between these two Daphnia populations. Overall, at the tested concentration, carbendazim induced low effects under a long-term exposure to a daphnid population.

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (P)
WE001
Development of a modelling framework for estimating the sorption of pharmaceuticals in soils
L. Carter, University of York / Environment Department; J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department

Ionisable pharmaceuticals comprise a significant and increasing proportion of chemicals used in Europe. At typical environmental pH, ionisable pharmaceuticals can become charged. Speciation can alter the fate and behaviour of a chemical in the environment including its sorption potential to soils and sludge. It is essential that this behaviour is recognised within chemical risk assessment and predictive approaches are able to account for how speciation alters chemical sorption. Several authors have proposed approaches to predict the sorption of ionisable chemicals in soils. However, these models are typically based on training sets containing a multitude of organic chemicals and their ability to predict ionisable pharmaceutical sorption specifically needs to be evaluated. We therefore evaluated a range of predictive approaches, that take into account sorbent properties (i.e., soil characteristics), for their suitability for estimating sorption of pharmaceuticals in soil. The evaluations were done using a database of high quality experimentally-determined pharmaceutical sorption coefficients provided by industry partners. Models developed for specific classes of ionisable chemicals (i.e., cations or anions) performed better in comparison to simple generic models, which assume that hydrophobicity is the key sorption mechanism and neglect to take into account of the effects of chemical speciation. Nevertheless, model predictions for anionic pharmaceuticals still performed poorly (r² < 0.5). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values while sorption was considerably overestimated for anionic organic matter and to clay minerals. As sorption of neutral and anionic compounds were not well explained by the evaluated models, further model development was required for adequate prediction of soil sorption coefficients for these classes of molecule. A decision tree framework to guide the selection of appropriate sorption models by taking into account soil pH and ionisable functional groups has been created. This incorporates previously published models that performed well in our analysis and the development of new sorption models. Work is currently on-going to review sludge sorption models and will be presented. The authors acknowledge EU/EFPPI Innovative Medicines Initiative Joint Undertaking (iP4E grant n° 115735) for the financial support.

WE002
Photochemical transformation and intermediate formation processes in surface waters, in the context of climate change
D. Vione, M. Minella, C. Minero, University of Torino / Chemistry

Sunlight illumination of surface waters induces several photochemical reactions that play significant roles in the natural environment without affecting the structure of the compounds and of xenobiotics, in the inactivation of pathogens and in biogeochemical cycles. These processes involve the direct photolysis of the target molecules (directly triggered by absorption of sunlight, if any), and their indirect or sensitised transformation. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrogen compounds) that subsequently produce several transient species that undergo photoinactivation and transformation reactions. The transients include, among others, the hydroxyl (OH) and carbonate (CO₃²⁻) radicals, singlet oxygen (¹O₂) and CDOM triplet states (CDOM*). Their occurrence in surface-water environments is linked to irradiance and to key water parameters such as chemistry and depth [1,2]. The phototransformation of dissolved compounds involves an interplay between molecular photoactivity and environmental features. Water chemistry and depth can affect both xenobiotics persistence and the possible formation of toxic or mutagenic intermediates. If an hazardous compound is preferentially produced by a certain photoreaction pathway, the environmental conditions can enhance or inhibit its formation in different surface-water environments [3]. The role of climate change on water chemistry and, as a consequence, on photochemical reactions is just starting to be investigated. The main difficulty is to disentangle climate effects from other disturbance factors (e.g. wastewater inputs) that may also operate and vary on the long term [4]. Climate change has the potential to deeply alter the photochemistry of freshwaters, but its effects could be very different in boreal versus temperate environments. In the former case the main effects would involve water clarity (i.e. increasing light availability), while in the latter case the role of phototransformation (e.g. photolysis, photobleaching, photolysis) may become dominant. However, a comprehensive understanding of the potential role of climate change on photochemical reactions is still needed. The present study aims at determining the impact of climate change on the occurrence of photochemical reactions in various surface-water environments.

WE003
How Pharmaceutical Industrial waste can make your medicines ineffective
N. Verma, Baddi University of Emerging Sciences & Technology / Pharmacy

Spread over 80 square kilometres in Himachal Pradesh’s Solan district, the Baddi-Barotiwala-Nalagarh (BBN) industrial area is one of India’s largest pharmaceutical manufacturing hubs. The region hosts around 500 small, medium and large pharma units and accounts for 35 per cent of Asia’s total medicine production. But rapid industrialisation and a lax attitude towards safe disposal and management of pharma waste has concerned about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into bushy areas. This released wastewater accumulates in or flows through nallahs, canals and rivulets into the Sirsa river. Effluents are also injected into the ground at night by digging bore wells or released during rains. Due to such practices, BBN register serious concern about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into bushy areas. This released wastewater accumulates in or flows through nallahs, canals and rivulets into the Sirsa river. Effluents are also injected into the ground at night by digging bore wells or released during rains. Due to such practices, BBN register serious concern about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into bushy areas. This released wastewater accumulates in or flows through nallahs, canals and rivulets into the Sirsa river. Effluents are also injected into the ground at night by digging bore wells or released during rains. Due to such practices, BBN register serious concern about the effects of pollution on the environment and health.

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APIs in the environment are plugged. The discharge of pharmaceutical effluents should take place through proper waste management techniques and stringent environmental regulations. Currently, effluent standards are limited to chemical contaminants such as heavy metals. The government must adopt a new AMR-centric approach of waste management which considers APIs as a chemical contaminant. Laws must be made to ensure that there are no APIs in treated effluents. The government should support small-scale manufacturers to install and improve environmentally sound treatment and disposal techniques. Manufacturers with high-end WWTPs should also be strictly monitored. The SPCBs should conduct surveillance of APIs or antibiotic residues in the treated effluents and make data publicly available.

**WE004**

The environmental concentration and evaluation of active ingredients in pharmaceuticals in rivers flowing through urban areas in Japan

T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; T. Suzuki, Y. Kosugi, K. Watanabe, Tokyo Metropolitan Institute of Public Health / Division of Environmental Health; A. Hirose, National Institute of Health Sciences / Division of Environmental Health; T. Nishimura

The active ingredients in pharmaceuticals are discharged into the aquatic environment after use mainly through sewage treatment facilities. There is concern about adverse effects on wildlife due to the possibility of the presence of highly susceptible species. However, we still know little about what kind of impact on wildlife in the environment. Based on these backgrounds, we set up environmental impact assessment methods for the pharmaceuticals according to AMED’s strategy and evaluated the risks. We have measured the environmental concentrations (MEC) of 31 kinds of active ingredients in marketing medicine, using liquid chromatography with mass spectrometry, in representative seven urban rivers in Japan, once every four seasons in 2015-2016. The maximum detected concentrations of the active ingredients exceeded 100ng/L are shown below: olmesartan (571ng/L), valsartan (45ng/L), irbesartan (13.9ng/L), candesartan (11.9ng/L), losartan (1.17ng/L) for antihypertensive agents, and sulpiride (546ng/L) for antipsychotic agents, citalopram (418ng/L) for antidepressants, and ramipril (150ng/L) for antihypertensive agents, bezafibrate (200ng/L) for hyperlipidemia treatment drug, crotamiton (845ng/L) for antipruritic agents, and sulpiride (546ng/L) for antipsychotic agents, citalopram (418ng/L) for antidepressants, and ramipril (150ng/L) for antihypertensive agents.

**WE005**

Evaluation of simple exposure models used for environmental prioritisation of active pharmaceutical ingredients

J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, L. Carter, University of York / Environment Department; E. Burns, University of York

Targeted quantification using analytical methods such as high performance liquid chromatography by tandem mass spectrometry (HPLC-MS/MS) are effectively used to monitor trace-levels (ng/L) of active pharmaceutical ingredients (API) in the aquatic environment. However, as more than 1500 chemicals are currently in use as pharmaceuticals, the high cost of HPLC-MS/MS prohibits its widespread use in the monitoring and prioritisation of APIs. Predictive exposure models may offer cheaper treatment water as it depends on the concentration of a specific ingredient at the time of measurement. The pharmaceuticals whose maximum detected concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candesartan, olmesartan, losartan, ramipril, and paracetamol. PECs may be best used for prioritisation over use in more sensitive applications, such as risk assessment, as PECs were consistently shown to underestimate API concentrations.

**WE006**

The role of the water-sediment simulation test and its outcome in the environmental risk assessment (ERA) of pharmaceuticals

D. Gildemeister, Umweltbundesamt / German Environment Agency; I. Rönnefahrt, German Environment Agency / IV.2.2 Pharmaceuticals; S. Schmitz, S. Zahorski, German Environment Agency / UBA / IV.2 Pharmaceuticals; A. Hein, I. Rönnefahrt, German Environment Agency - UBA / Section IV 2.2 Pharmaceuticals

In view of the revision of the "Guideline on the environmental risk assessment of medicinal products for human use" (EMEA/CHMP/SWP/4474/00, June 2006, rev. 2) current fate assessment is highly discussed concerning the water-sediment simulation test in tier A of the guideline. At the moment, only the partitioning into sediment triggers further assessment in the next tier of the guideline. Derived half lives were not used in refined predicted exposure concentration (PEC) calculations and transformation products (TP) were not specifically considered in the ERA. Now, UBA evaluates the data received in the last 10 years in order to determine the gaps and the benefit of the current fate assessment for the overall risk assessment e.g. classification of persistence. Especially the role of TP in the environment due to their frequent higher mobility compared to the parent compound is considered in the presented research. As a first step an overview is prepared on the overall performance of pharmaceuticals in the ERA in the future. It is clearly demonstrated that total system half-lives already show a high persistence of pharmaceuticals in the aquatic environment. Furthermore it should be considered that especially for the sediment compartment often no kinetic model fits well enough to predict DT50 values. The risk of ground water contamination by bank filtrations will be estimated by the lipophilicity/hydrophilicity of the parent compound and TP. The occurrence and identification of TP is often appeared to be something which is only “nice to have” but not really relevant for the risk assessment of human pharmaceuticals. TP are often more polar and stable in environmental compartments than the parent compounds. This is of high relevance for groundwater contamination. The identification of relevant TP is still often missing in provoked studies. The water-sediment simulation study is the only experimental study in the ERA which gives information about the possible behaviour and occurrence of parent compounds and TP in surface waters. Such results are relevant for monitoring and for the understanding which compartments are affected by pharmaceuticals. Instead of waiving OECD 308, the results should be better included in the ERA and communicated.

**WE007**

Expert System to Inform BCF Testing Strategies for Pharmaceuticals

A. Agatz, IBACON GmbH / Environment Department; L. Carter, University of York / Environment Department; P. Andrews, A. Nellig, SimOncics; S. Owen, AstraZeneca / Safety Health Environment; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; J. Timmis, SimOncics; A. Boxall, University of York / Environment Department

An important part of the environmental risk assessment (ERA) of pharmaceutical ingredients is the identification of the persistent, toxic and bioaccumulative properties (PBT assessment) of the molecule. Regulations and guidelines on how to conduct this assessment and what empirical data are required to do so are increasingly complex. Currently a large number of fish are used as part of the ERA process, particularly for experiments to determine the bioconcentration factor (BCF), even though research developments and guidelines already contain opportunities to significantly reduce the number of fish used via alternative methods of exposure. A novel tool to support the BCF testing of pharmaceutical ingredients by interpreting regulatory needs and considering existing guidelines and the wider literature. The system generates transparent and evidence-based compound specific BCF assessment reports and BCF testing strategies if testing is required. In our strategy, the P and T Assessments are conducted before the B assessment because the cut-off test is currently only required to be conducted to categorise the compound as PBT or vPvB. Thus empirical BCF values are not always required as decisions are made according to specific trigger values which are either exceeded by a compound or not. This means that in many cases the use of appropriate BCF prediction models prevents the need for experimentation. If a fish BCF test is required, our tool suggests an experimental design with the ultimate aim of reducing the number of test organisms needed without sacrificing the test validity criteria. The novelty of our system is that it illustrates, in a transparent manner, how the system made its decisions by incorporation of the argumentation tool ArtPro. This tool visualises the system’s decision incorporating what regulatory and guideline
background was used to support that decision and what data, modelling approaches and assumptions were used in addition to the sources of data. Preliminary analysis of those compounds for which empirical fish BCF data are available in the literature against our new strategy revealed that if our strategy was followed in at least 19% of those cases an empirical study would have not been required.

WE008

Development of a quantitative Adverse Outcome Pathway-informed model to predict the risk posed by mixtures of non-steroidal anti-inflammatory drugs to fish

P. Marmon, J. Kayode, Brunel University London / College of Life Sciences; S. Owen, AstraZeneca / Safety Health Environment; L. Margiotta-Casaluci, Brunel University London / Institute of Environment, Health and Society

The presence of low concentrations of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised the concern that chronic exposure to these compounds may cause adverse effects in wild fish populations, similar to those observed in human patients. This potential scenario has led to the inclusion of diclofenac in the European Union Watch List of emerging pollutants. Although the effects of diclofenac in fish have been investigated in over twenty published studies to date, the complexity of NSAIDs toxicity is such that many uncertainties still exist about the significance of those findings for environmental risk assessment. We hypothesise that the perturbation of cytochrome P450 activity in healthy fish tissues is the leading cause of adverse effects, as it is in humans. On the basis of this mechanistic starting point, we propose a quantitative Adverse Outcome Pathway for diclofenac exposure to aquatic organisms and pharmacodynamic aspects of NSAIDs toxicity. After extracting all NSAIDs toxicity data available in the scientific literature, we applied drug uptake models to predict the plasma concentrations at which different effects would occur in laboratory studies. As all NSAIDs act by inhibiting the enzymes COX1 and/or COX2, we applied mixture pharmacology approaches to express the plasma effect concentrations (PECs) as dichotomous endpoints, similar to drug efficacy in human medicine. We used this approach to express the potential of NSAIDs mixtures, expressed as diclofenac-equivalents. We propose that this mechanistic approach may provide a useful predictive tool to support the implementation of effective NSAIDs ecopharmacovigilance strategies and facilitate the regulatory interpretation of past and future toxicity data.

WE009

Evolution in the lab - How can we study the chronic exposure to pharmaceuticals over multiple generations?

K. Heye, Goethe University Frankfurt/Main / Aquatic Toxicology; A. Schmidt, Goethe University Frankfurt / Aquatic Ecotoxicology; J. Oehlmann, Johann Wolfgang Goethe-Universität Frankfurt / Aquatic Ecotoxicology

Larval experiments are a helpful tool to investigate the long-term effects of chemicals on aquatic organisms. Within the first six months of the ongoing study, midges showed to be less sensitive to carbamazepine after long-term low-level exposure. Chronic toxicity tests to study the authors of exposure groups should be combined with genome and transcriptome analyses to get a full picture of adaptation processes in midges. Acknowledgement - The authors thank the Federal Ministry of Education and Research (BMBF) for funding (NiddaMan, project support code: 02WRM1367A).

Effects of duloxetine and econazole on freshwater species towards individual and combined conditions

G. AMARIELI, Universidad de Alcalá; K. Boltes, University of Alcalá / Chemical Engineering; J. Valimäa-Traverso, M. García, P. Letón, M. Marina, R. Rosal, University of Alcalá

Thousand of biologically active pharmaceutical ingredients (APIs) are used in human and veterinary medicine over the world. Nowadays, the occurrence of pharmaceuticals in aquatic environments is a well-established issue, there are still gaps in our knowledge on the fate and effects of these compounds in the environment. Evaluating API ecotoxicology is even more challenging due to uncertainties about appropriate dosages, durations of exposure, range of sensitive taxa, sensitivity of developmental stages, and toxicological endpoints. More attention should be paid on the non-target organisms and the chiral nature of contaminants. This work assess the toxicity of the antidepressant drug Duloxetine and the antifungal Econazole, individually and combined, on three freshwater species—algae, crustacean and duckweed, using APIs concentration from 0.039 to 100 mg L⁻¹. Level a type of drugs interactions were determined using the Combination Index-isobologram method. The enantiomers concentration of the target compounds in the culture media were varied. To analyze the interaction between degradation profile and the observed toxicity on organisms. Results reveal toxic effects of Duloxetine and Econazole leading to growth reduction and significant changes in the morphology of duckweed fronds. The EC50 values obtained shown Duloxetine as very toxic for algae and toxic for crustacean and plants. Econazole appears as very toxic for all species evaluated. Mixed toxic profile for APIs, and for toxic APIs (TCAs) are now on the market worldwide. It is possible to measure the concentrations of selected antidepressants by chemical analysis, but such concentrations do not indicate the physiological activity of antidepressants in water. For example, even if the concentration of each substance is low, through additivity compounds might produce a strong enough physiological activity to harm aquatic organisms. To determine whether antidepressants (SSRIs, SNRIs, TCAs) and their metabolites are toxic to aquatic organisms, we must know the extent to which such compounds may be exposed to antidepressants as determined by the inhibition of monoamine transporter proteins in the liver. In this study, we measured the physiological activity of antidepressants in WWT effluents for the first time by the in vitro assay (namely called antidepressant assay). We utilized fluorescence substrate, APP, for monoamine transporters (serotonin transporters (SERT), dopamine transporter (DAT)). By transfecting a plasmid expressing transporter into cultured cell line, and measuring the fluorescence intensity inside the transfected cells, inhibitory activity of antidepressant on the uptake of APP by transporter could be quantified. We applied the antidepressant assay to secondary effluents (SEs) of WWTPs in Japan, and determined to detect the inhibitory activity of antidepressants in SEs. Inhibition was detected in SERT or NET-expressing cells, but not in DAT-expressing cells, suggesting that detected inhibitory activity come from SSRIs, SNRIs, and/or TCAs, not DRI s in SEs. Activities detected in SEs could be quantified as antidepressant-equivalent quantities (EQs). By comparing EQ values with the effective concentrations of antidepressants in vivo behavior testing, we can know whether antidepressants in environmental water is really risky to aquatic organisms.

WE010

Toxicology of pharmaceuticals to aquatic organisms: a meta-analysis of effects on development and reproduction

V.F. Fonseca, I.A. Duarte, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUC; B.M. Gillanders, School of Biological Sciences, The University of Adelaide / Southern Seas Ecology Laboratories; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre
The ubiquity of pharmaceutical compounds in the aquatic environment, their growing use and their potential to elicit biological effects even at low concentrations is a major concern to environmental health and safety management. In recent years an increasing number of studies have addressed the presence and toxicity of various pharmaceuticals, using various biological endpoints in different biological models, and reporting varying effects. Accordingly, a systematic quick literature assessment is key to improve current understanding of the ecological risks of pharmaceuticals at the community level.

To unravel patterns in biological responses across aquatic taxa a meta-analysis was performed on reported effects of exposure to pharmaceutical compounds (according to therapeutic class). Minimum response concentration and biological responses were collected from selected studies based on a set of objective criteria, considering organisms’ exposure to pharmaceuticals under controlled conditions. For a response sensitivity analysis various endpoints were considered, namely biochemical, developmental (e.g. growth), reproductive and behavioral responses, as well as lethality, in studies reporting effects on aquatic taxa. The comparative sensitivity analysis of biological endpoints highlighted the sensitivity of molecular responses, followed by individual level-responses (e.g. behavior and growth), yet variable sensitivity was among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

**WE013 Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals**

E. Unaganyiro, Shantou University / Marine Biology Institute; J. Gan, Universidad de Cantabria; R. Heins, Department of Environmental Sciences

Pharmaceuticals are frequently detected in wastewater and the environment at concentrations ranging from ng/L to µg/L. More than 50 % pharmaceuticals are chiral compounds. Enantiomers of chiral pharmaceuticals have been shown to exhibit differences in environmental fate, transport and toxicity. Since more than 2,500 pharmaceuticals are currently in use, it is implausible to carry out whole organism toxicity studies of all pharmaceuticals. However, there is a wealth of knowledge available from drug discovery and development research that can be leveraged for predicting potential environmental exposure and effects of chiral pharmaceuticals. Assuming evolutionary conservation of primary drug target, read-across method can be used to predict the potential effect of chiral pharmaceuticals. In this study, we estimated the stereoselective effect of 11 chiral pharmaceuticals using the fish plasma model. We found metoprolol had high risk with an effect ratio, ER (ratio of human therapeutic plasma concentration to fish plasma concentration at steady state) that was less than 1.0, whereas propranolol, salbutamol, fluoride and venlafaxine were medium risk (1.0 < ER < 30). However, stereoselectivity was predicted in all compounds except atenolol and pindolol. In this study, we showed the fish plasma model has considerable potential as a model for predicting stereoselective toxicity of chiral pharmaceuticals.

**WE014 Effects of benzoylecgonine exposure at different levels of the biological hierarchy on Daphnia magna**

M. Parolini, Università degli Studi di Milano; Department of Environmental Science and Policy; B. De Felice, Università degli Studi di Milano; C. Ferrario, University of Milano Bicocca; N. Salgueiro-Gonzalez, IRCSS Istituto di Ricerche Farmacologiche Mario Negri; S. Castiglioni, Mario Negri Institute / Environmental Health Sciences; P. Torello, University of Milano / Department of Biomolecular Sciences and Biotechnology; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences

A number of monitoring studies have shown that benzoylecgonine (BE), a metabolite of cocaine, is the main illicit drug residue measured in both wastewater and surface waters worldwide. Although the aquatic concentration of BE can be considered still low, the exposure to this molecule may cause diverse adverse effects. The few studies that have demonstrated this: we investigated the toxicity of this molecule towards invertebrate and vertebrate aquatic non-target organisms have shown different detrimental effects at low levels of the biological organization, mainly at biochemical, molecular and cellular levels. However, to date no one study has evaluated the consequences of BE exposure to the higher levels of ecological hierarchy. Thus, the present study was aimed at investigating the toxicity of a 48-h exposure to 15 concentrations of BE, similar to those found in aquatic ecosystems (0.5 µg/L and 1.0 µg/L), on the cladoceran *Daphnia magna* at different levels of the ecological hierarchy. We relied on a multi-level approach focusing on the effects at biochemical/biomolecular (biomarkers), individual (swimming activity) and population (reproduction) levels. As previous studies of BE have shown that this molecule can induce oxidative stress, we assessed the amount of reactive oxygen species and of the activity of antioxidant (SOD, CAT, and GPx) and detoxifying (GST) enzymes and the lipid peroxidation (TBARS) as oxidative stress endpoints. We also measured the acetylcholinesterase (AChE) activity because this enzyme is strictly related to behavioral changes in aquatic organisms. Alterations in the swimming behaviour of *D. magna* were investigated by a video tracking analysis, while the consequences on the reproduction were assessed by a chronic toxicity test. Our results showed that the exposure to two BE concentrations similar to those found in aquatic ecosystems induced oxidative stress and inhibited the activity of AChE, affecting the swimming behaviour and the reproduction of *Daphnia magna* individuals.

**WE015 Impact of the antibiotic drug metformin and its transformation product guanylurea on brown trout (Salmo trutta f. fario)**

S. Jacob, Universität Tübingen / Animal Physiological Ecology; L. Kundy, M. Biecker, University of Tübingen; R. Triebkorn, University of Tübingen / Animal Physiological Ecology

The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antibiotic drugs as metformin (MF) has become obvious. In wastewater treatment plants, metformin is only partially retained and also transformed to guanylurea (GU) leading to high concentrations of both compounds in surface waters. However, possible effects of MF and GU in aquatic organisms are far from being understood. The aim of this study is therefore to investigate influences of MF and GU on different metabolic pathways and behaviour in different life stages of brown trout (*Salmo trutta f. fario*). Juvenile trout (age: 8 month) were exposed for 4 weeks at 7 °C to different concentrations of MF (0, 10, 1000 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 100, 1000 µg/L) at 7 °C & 11 °C (regarding possible interactions of chemical toxicity & temperature). To show influences on the embryo development, mortality, hatching rate, and heart rate were recorded. Tissue samples were taken three and eight weeks after the end of the sac-fry stage. In all experiments, several endpoints characterizing fish health were investigated, including the histological condition of the liver, alterations in the stress protein level (atf-3/0), changes in the intestinal microbiome and additionally the glycogen storage in the liver of MF-exposed fish. Besides, swimming and predator-prey behaviour were investigated. There was no influence of MF on the developmental parameters in brown trout larvae. Neither behaviour nor stress protein level were influenced by MF. The liver tissue of the MF-exposed trout was in a good condition. The glycogen storage was tendentially increasing in MF-exposed fish compared to the control, whereas the glycogen content of the trout exposed to 1000 µg/L MF was partially decreased. The intestinal microbiome of MF-exposed larvae showed a significantly different composition compared to the control. The results for the experiment with GU will be presented (analyses not yet finished). This work is part of the project Eff-Net (Effect Network in Water Research) funded by the Aquaturm Baden-Baden. The data availability and comparability across method can be used to predict the potential effect of chiral pharmaceuticals using the fish plasma model.

**WE016 Effect of life-cycle exposure to environmentally relevant concentrations of metformin and its metabolite guanylurea on F1 progeny 28 days post hatch.**

Z.P. Pandelides, University of Ontario Institute of Technology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science Research. Results have demonstrated that the type 2 diabetic drug metformin and its known metabolite, guanylurea, are common environmental contaminants found in the ng-/µg/L concentration range in surface waters and wastewater effluent. This should be of concern as recent work in our lab shows that Japanese medaka (*Oryzias latipes*) exposed to environmentally relevant concentrations of metformin and guanylurea from embryo through 28 days post-hatch have a significant decrease in length and weight of both males and females when compared to control fish. Furthermore, our studies show that larvae exposed for 28 days to both compounds have a significant dysregulation in lipid and fatty acid metabolism, possibly leading to this stunted growth. A full life-cycle exposure to both compounds at environmentally relevant concentrations, alone and in combination, was performed in order to examine the effects of chronic exposure to the F1 progeny. The effects of metformin and guanylurea on the length and wet weight were compared 28 days post hatch and will be discussed. Possible implications of exposure to metabolomics and gene expression will be explored.

**WE017 Life-cycle effects in Oryzias latipes exposed to environmentally relevant concentrations of metformin and its metabolite, guanylurea.**

E. Ussery, University of Ontario Institute of Technology / Biological Sciences; Z.P. Pandelides, University of Ontario Institute of Technology / Biological Sciences; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science Research. One of the current most common contaminants in the aquatic environment is the type 2 diabetic drug metformin. Metformin has been measured in the ng-/µg/L concentration range in both German and North American surface waters and wastewater effluent. As the majority (>90%) of metformin is metabolized into
guanirylaua during the waste water treatment process, it is found in the environment in higher concentrations than metformin, usually in the pg/L concentration range in surface waters. This is concerning, as our recent research shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin (1.0–100 µg/L) and guanirylaua (10–100 ng/L) from embryo through 28 days post hach have a significant decrease in length (mm) and weight (mg) of both male and female fish when compared to control fish, with guanirylaua appearing to be roughly 1,000 times more potent than its parent compound, metformin. Furthermore, these studies show significant changes in the metabolome of 28 day old male medaka exposed to both metformin and guanirylaua, indicating significant dysregulation in fatty acid and lipid metabolism. These results raised concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds at environmentally relevant concentrations, alone and in combination, was conducted in order to examine the effects of chronic exposure on growth, reproduction, steroid production, and gene expression. Results will be discussed.

WE018 Environmental Fate and Effects of the Antidiabetic Drug Metformin and Its Transformation Product Gualunyela J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health Safety Sustainability; V. D’Aclo, Quantum Management Group, Inc.; T. Davidson, Bioinformatics Department, AstraZeneca / Safety Health Environment; B. Simon, Merck & Company, Inc. / Global Safety the Environment

Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excreted in unchanged form. This has led to concerns about the potential aquatic life impacts associated with the presence of MET in surface waters. MET is metabolized in the liver to GUU. The USEPA, EU and AstraZeneca / Safety Health Environment; B. Simon, Merck & Company, Inc. / Global Safety the Environment conducted to support new drug registration applications as well as new studies commissioned to fill data gaps. Predicted environmental concentrations (PECs) for MET were modelled based on documented usage for the USA with the PhATE model and for the European Union with the GREAT-ER model. These PECs were compared with measured environmental concentrations (MECs) for both the USA and EU. A predicted no effect concentration (PNEC) for MET was derived by deterministic procedures based on multiple chronic studies with algae (4), daphnids (5) and fish (5, two species). Both the PEC/PNEC and MEC/PNEC risk characterization ratios were well below 1, indicating no significant risk for MET with high margins of Safety. However, since MET is known to be primarily degraded during wastewater treatment to GUU, relevant chronic studies for GUU were conducted to derive a PNEC. In addition, PECs were derived for GUU for the USA and EU as above for MET. Fate and removal/in-stream-loss parameters for both MET and GUU significantly transformed the PECs in the environment. A predicted no effect concentration (PNEC) for GUU was derived by the PhATE model and for the European Union with the GREAT-ER model. These PECs were compared with measured environmental concentrations (MECs) for both the USA and EU. A predicted no effect concentration (PNEC) for GUU was derived by deterministic procedures based on multiple chronic studies with algae (4), daphnids (5) and fish (5, two species). Both the PEC/PNEC and MEC/PNEC risk characterization ratios were also well below 1. We conclude there is no significant risk to aquatic life for both MET and its transformation product GUU.

WE019 Fluoxetine exposure modulated antioxidant and anxiety-related gene expression altering swimming activity in zebrafish embryos B. De Felice, Università degli Studi di Milano; A. Ghilardi, L. Del Giacco, University of Milan; M. Parolini, University of Milan / Department of Environmental Science and Policy

The massive release of human pharmaceuticals into the aquatic ecosystems continues to be a serious environmental problem. Among pharmaceuticals, psychotropic drugs such as antidepressants are one of the main therapeutic classes, which can affect neurotransmission and, consequently, alter swimming behavior of zebrafish. This drug ca...

WE020 Bio-Optical probing of Beazaltric acid in model marine diatom Phaeodactylum tricornutum B. Durand, MARE - Marine and Environmental Sciences Centre / Centro de Oceanografia; A. Matos, BiosSIBiSsosytems and Integrative Sciences Institute / Plant Functional Genomics Group, T. Cabrita, IPMA IP; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; I. Caçador, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre; H. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V. E. Fonseca, MARE Marine and Environmental Sciences Centre

The occurrence and fate of pharmaceutical active compounds in aquatic environments has become a major cause for concern due to their effects on humans and aquatic ecosystems. The high consumption of blood lipid regulators is leading to increased occurrence of lipids in natural streams and wastewater effluents. Crude Fish oil is a class of drugs derived from fish oil acid widely used to reduce plasma triglyceride levels and raise the level of high-density lipoprotein cholesterol.

Specifically, Beazaltric is extensively used as a lipid regulator with consumption greatly increasing over the years in developed countries. Due to its large use and its persistence, beazaltric has been detected in surface and drinking waters as well as in wastewater effluents. This can have serious effects on marine life, in particular marine primary producers and thus impacting the whole system productivity and functioning. Exposing the model diatom Phaeodactylum tricornutum to a range of environmentally relevant concentrations of beazaltric (0–60 µg/L) revealed no serious impacts on cell growth. Nevertheless, after 48h of exposure damages in the photosynthetic apparatus were detected using bio-physical probing Pulse Amplitude Modulated (PAM) Fluorometry. Beazaltric exposure impaired both photosystems, which reduced the algae ability to harvest photonic light and convert it into an electron flow, and thus its chemical energy production (ATP). This may result from a direct effect of beazaltric in membrane fatty acids from the chloroplast, since both photosytems are anchored in a lipidic membrane system. Moreover, triglycerides (TAGs) are known to protect the photosystems against photoinhibition. The reduction of TAGs could lead to burnout of the photosystems due to excessive energy being absorbed, as observed by the high incoming photonic energy flux, which may reduce the ability of active reaction centers in the algae and thus its photosynthetic activity. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for beazaltric toxicity testing in marine systems, screened by non-invasive high-throughput bio-physical probing tools.

WE021 Environmental Risk Assessment for the Active Pharmaceutical Ingredient Mycrophenolic Acid in European Surface Waters J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; A. Haener, F. Hoffmann-La Roche Ltd / Group SHE

An Environmental Risk Assessment (ERA) was performed for the active pharmaceutical ingredient mycrophenolic acid (MPA) for Europe. MPA is an older immune inhibitor developed in the USA in the 1990s by Syntex, Inc., now a part of the Roche Group. So far, no sufficient dataset describing biodegradability, environmental fate or ecotoxicity for MPA nor an ERA for MPA have been available. The present ERA is based on old environmental data from Syntex on and new tests, all performed under GLP quality assurance, for physico-chemical characteristics, partitioning, environmental fate, biodegradability and (sub)chronic/ecotoxicity and on sales amounts for the products containing MPA in Europe. A predicted environmental concentration (PEC) in Europe from all products containing MPA was calculated based on compound actual use data from IMS Health, Inc. per annum and country, incorporating population data from Eurostat, for the decade 2004–2014. A crude initial PEC was derived based on standard ERA assumptions of no removal in sewage treatment or surface waters. The crude PEC was refined by incorporating predicted sewage works removal, based on new biodegradability data, and by country-specific dilution factors. The lowest of the no observed effect concentrations from chronic and subchronic tests with algae, daphnia and fish was divided by an assessment factor of 10 to derive the chronic persistence impaired no effect concentration (PNEC). Potential risk for surface waters was then quantified by dividing the PECs by the PNEC. Potential risk from MPA was also assessed for sewage works and bacterial populations. In addition, MPA is not expected to bioaccumulate nor to adsorb to sewage sludge or to sediment to a significant extent. Conclusions on potential risks of MPA are given in the poster.

WE022 Cytostatics in Dutch surface water - overview of use and potential risks to the aquatic environment 334 SETAC Europe 28th Annual Meeting Abstract Book

B. Duarte, MARE / Department of Life Sciences, University of Coimbra; I. Caçador, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V. E. Fonseca, MARE Marine and Environmental Sciences Centre
pharmaceutical groups/mode of actions will be given in the final poster. Our results are sensitive in one quarter, each. Detailed information concerning specific organism in more than half of the cases, while algae and plants, and the available monitoring data in Dutch surface waters. For these 10 cytostatics, available environmental fate and effect data were gathered and safe environmental concentrations were derived. Comparison to predicted and measured environmental concentrations will allow to conclude if the selected cytostatics pose a risk potential to the aquatic environment. First, an inventory was made of cytostatics use in the Netherlands. A set of the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at 10 ng/L; with a cumulative activity and neuronal system development, and a general alteration of the lipid metabolism, effects on cell metabolism and cell death, and a specific immune response, and different endocrine systems. We present a case study comprising two substances in order to highlight possible uncertainties for applicant companies, as well as for competent authorities.

Obsogens and lipid disruptors (P)

Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses


In the context of the EU veterinary medicines marketing authorisation procedure T. Hahn, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; C. Floeter, HAW Hamburg / Department of Environmental Engineering; S. Schwonbeck, G. Koennecker, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment.

The marketing authorisation process for veterinary pharmaceuticals in the EU and other countries requires an environmental impact assessment (EIA) for each veterinary medicinal product (VMP). This EIA follows a phased approach with conservative estimates of environmental exposure in phase I, which may later require refinement by experimental data in phase II. Core of the phase I assessment is a catalogue of 19 questions on use and characteristics of the VMP under consultation. These questions aim at establishing an initial predicted environmental concentration, which, together with information on therapeutic use and targeted animals, needs to be further investigated as part of an in-depth phase II assessment. According to question 2 in the phase I assessment a substance is exempted from further investigation when there is scientific proof that it is a natural substance “the use of which will not alter the concentration or distribution in the environment”. At first sight this definition appears unambiguous. Nevertheless may it be a hurdle for applicants because no further guidance is given which criteria apply for acceptance or rejection of a given concentration as ‘natural’. Here, we present a case study comprising two substances in order to highlight possible uncertainties for applicant companies, as well as for competent authorities.

SETAC Pharmaceuticals Interest Group

G. Maqas, German Environment Agency / Ecotoxicological Assessment

Pharmaceuticals; K. Westphal

WE024

Prioritisation of human pharmaceutical substances - a regulatory perspective

I. Rommelhahn, German Environment Agency - UBA / Section IV 2.2 Pharmaceuticals; S. Konradi, Federal Environment Agency (Unverbindlichstes) / Section IV 2.2 Pharmaceuticals; A. Hein, S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; K. Westphal-Settele, German Environment Agency (UBA) / Section IV 2.2 Pharmaceuticals; I. Ebert, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals

Pharmaceuticals in the environment have been recognized by the European Commission as emerging issue. Possible actions to reduce their emission into the environment and the need for amendments of the legislation are currently discussed in the ‘strategic approach to pharmaceuticals in the environment’.

At the German market, there are currently about 2300 active pharmaceutical substances used in human medicinal products; at least 1200 of them are compounds of potential environmental concern. For the majority of these 1200 compounds data for an environmental risk assessment (ERA) are incomplete or lacking, with the result that their potential environmental impact cannot be assessed in an appropriate manner. The reason for this is simple: So called ‘legacy products’ have been authorised before the ‘Guideline on the environmental risk assessment of medicinal products for human use’ came into effect in 2006. According to the current legislation all legacy products have to be exempted from further investigation when there is scientific proof that it is a natural substance “the use of which will not alter the concentration or distribution in the environment”. At first sight this definition appears unambiguous. Nevertheless may it be a hurdle for applicants because no further guidance is given which criteria apply for acceptance or rejection of a given concentration as ‘natural’. Here, we present a case study comprising two substances in order to highlight possible uncertainties for applicant companies, as well as for competent authorities.

Obsogens and lipid disruptors (P)

Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses


Exposure to PFOS (perfluorinated octyl) sulfonate) has been related to toxic effects on lipid metabolism, immunological response, and different endocrine systems. We present here a combined metabolomic and transcriptomic analysis of zebrafish embryos exposed to different concentrations of PFOS (30-1000 ppb) from 48 to 120 hpf. While parallel morphological analysis showed no macroscopic changes below the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at the lowest used concentration. Functional analysis of the observed changes revealed at least three major modes of action: alteration of PPAR signalling and lipid metabolism, effects on cell-cell interaction, perhaps linked to effects on the immuno response and neuronal system development, and a general alteration of the development, reflected by an alteration of different development- and metabolism-related signalling pathways, likely affecting to cell cycle functions, and
to the metabolism of proteins, nucleotides, and amino acids. The results suggest a complex, multiple endocrine disruption-like toxic effects, at a concentrations well below the 1 ppm considered the LOAEC/NOAEC for many of the macroscopic effects traditionally linked to PFOS toxicity in zebrafish embryos, including lipid disruption, effects to sensorial organs, and lethality. It is also remarkable the functional correlation between these macroscopic effects and the molecular changes we observed at metabolic and/or transcriptomic levels at concentrations 10 to 100 below the macroscopic NOAEL.

**WE028 Impacts of fatty acids and methylmercury on preadipocyte differentiation in rainbow trout (Oncorhynchus mykiss).**

G. Martínez, Universidad Autónoma de Baja California Sur; C. Cabrera, Universidad Autónoma de Baja California Sur / Instituto de Investigaciones Biológicas y Ambientales (IIBA); Ž. Kupčič, University of Veterinary and Agricultural Sciences Prague; J. Vančíková, University of Veterinary and Agricultural Sciences Prague / Biology; P. Vojtech, University of Veterinary and Agricultural Sciences Prague / Chemistry.

Fish are exposed to a variety of environmental contaminants that may alter their metabolism. Fish in the aquatic environment, potentially affecting its ecosystems. In fact, reports show that environmental chemicals are able to alter lipid homeostasis, which can have a wide range of effects on the organism and cell levels. Regarding the effects of MeHg, we can highlight the presence of cells with more typical adipocyte morphology in the presence of hormonal cocktail and MeHg. For example, at day 13, for each FA, the higher the concentration, the more the lipid accumulation. At 600 mM, HDA and DPA were the most adipogenic FA, while LA and ALA (typical to plants) induced less lipid accumulation. For all conditions, a clear enrichment of membranes and lipid droplets with the incubated FA was observed. Effects of MeHg - Confluent cells were incubated for 6 days with or without a hormonal cocktail, with 0.5, 2.5 or 5 mM MeHg and with 4 µM lipid mixture. No cytotoxicity was observed. At day 6, cells were collected to determine mercury concentration, FA content and composition, and gene expression. Analyses are in progress. Preliminary results showed that the hormonal cocktail combined to increased MeHg concentrations tended to affect cell morphology, towards a more typical adipocyte phenotype. In contrast, LA as a combination of FA can be different at organism and cell levels. Regarding the effects of MeHg, we can highlight the presence of cells with typical adipocyte morphology in the presence of hormonal cocktail and MeHg. For both experiments, analyses of expression of genes related to adipocyte differentiation, lipid metabolism and lipolysis are under progress and could provide helpful results to understand better the impacts of stressors in trout preadipocytes.

**WE029 Obesogens in the aquatic environment**

A. Capitão, CIIMAR / Universidade do Porto; A. Lyssimachou, CIIMAR; F. Castro, CIIMAR - University of Porto; M.M. Santos, CIIMAR/FCUP / Biology/Endocrine disruptors and Emerging contaminants.

The prevalence of obesity is a major health concern of our times, affecting an increasing proportion of the population worldwide. It is now evident that this phenomenon is not only associated with the lack of exercise and a balanced diet, but also due to environmental factors, such as exposure to environmental chemicals that interfere with lipid homeostasis. These chemicals, also known as obesogens, are present in a wide range of products of our daily life, such as cosmetics, plastics, food cans and pesticide-treated food, among others. A growing body of evidence indicates that their action is not limited to mammals. Obesogens also end up in the aquatic environment, potentially affecting its ecosystems. In fact, reports show that environmental chemicals are able to alter lipid homeostasis, impacting weight, lipid profile, signaling pathways and/or protein activity, of several kinds of animals. Such a priority area in aquatic toxicology. One of the most prevalent pharmaceutical contaminants is the type 2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolites, we conducted experiments with Japanese medaka (Oryzias latipes) when exposed to 3.2 µg/L metformin from embryo through 28 day post hatch. When male medaka were exposed to an extremely low concentration of guanylurea (1.0 ng/L), there was a similar percent decrease in length and wet weight. Using radio labeled metformin, we demonstrated that about 1% of the waterborne concentration of metformin could be taken up in both embryo and larval medaka after exposure windows ranging from 24 hours to 7 days. We also conducted a metabolomics assessment of metformin and guanylurea exposed fish to elucidate the sub-lethal biochemical mode of action for each contaminant exposure. Significant changes were detected in the metabolome of 28-day larval male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. This biochemical effect is likely a contributing factor to the observed decreased growth in exposed fish. In combination, these results suggest that the current concentrations of metformin and guanylurea in receiving waters are of ecotoxicological concern for resident fish populations.

**WE030 Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopecten ventricosus (Sowerby, 1842), exposed to toxic metals**

A. Sebrío-Figueiras, Universidad Autónoma Metropolitana Iztapalapa / Biología; C. Cáceres, Universidad Autónoma Metropolitana Iztapalapa / Biología; A. Portuondo, Universidad del Sur California Sur

The analysis of the composition of the digestive gland, gives information on the energy level of the organism, this energy is mobilized in the different stages of its life cycle. When the organisms are subjected to severe stress conditions, it has been observed the mobilization of these reserves to maintain homeostasis, in short periods of time. In this work, an evaluation of the composition of the digestive gland of juvenile catarina clam exposed to the metals Cd, Cr, Pb and their mixtures was carried out to determine their energy content. Bioassays with water replacements were carried out. The organisms were exposed to 1 sub lethal concentration of each metal (LC50) (0.35, 5.0 and 3.0 mg L^-1_ of Cd, Cr and Pb.
respectively) and of the mixtures in proportion 1:1. The levels of proteins (Lowry, 1951), carbohydrates (Dubois, 1956), lipids (Bligh and Dyer, 1959) and cholesterol (Kit Biorad) were quantified at 24, 96, 144 and 168 hours after the start of the bioassay. The Krusal-Wallis test showed that the difference between the concentrations of proteins, lipids, cholesterol and carbohydrates of the control group compared to the treatments was significant (p < 0.034). An increase in cholesterol levels was observed at 24 hours of exposure and a decrease for lipids and carbohydrate levels of up to 75% in only 96 hours (4 days) of exposure to metals and their mixtures. This indicates that juveniles exposed to metals had high stress levels, as was also observed in relation O:N. It should be mentioned that the surviving organisms of the tests, died 48 hours (2 days) after it was observed the mobilization of their energy reserves.

Environmental risk assessment and management of the spoil material produced in tunnelling excavation (P)

**WO033** Environmental assessment of foaming agent persistence in conditioned soil for EBP-TBM tunnelling


Earth Pressure Balanced Shields are currently the most used full face tunnelling machine thanks to the wide use of conditioning agents in different soil types that change the mechanical and hydraulic behaviour of the soil into a plastic paste, permitting soil pressure applications in the bulk chamber. The most frequently conditioning agents used for soil in the bulk chamber are various types of foams that are injected to the soil from injection points located on the cutter head and inside the bulk chamber to give the conditioned soil properties necessary to guarantee that the EPB machine will work in the proper way. The excavation process produces a large amount of spoil material rich in foaming agents that can have an impact on ecosystems. The possible way-of-use of the excavation products strongly depend on the additive composition, on soil properties and environmental conditions. Currently, there are neither soil threshold limits in European legislation for these components nor comprehensive studies on their environmental risk and persistence for soil ecosystems in these exposure scenarios. In this context, the objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained as the main component of two commercial foaming agents in two different soils (S1: silty-clay; S2: gravel in a clay-silty-sand matrix soils) sampled from a construction site. Moreover, the degradability of one product was evaluated in the presence of an additive used to improve the compactness and subsequently transport of the spoil material. For this purpose, microcosms were set up using soil samples conditioned separately with the two foaming agents. Control microcosms, consisting of un-treated soil, were also set-up to compare the microbial community before and after the foaming agent addition. At selected times, soil samples were collected for assessing SLES concentration by AEX extraction followed by MBAS spectrophotometric method. Microbiological analyses were performed in order to assess microbial abundance, viability and dehydrogenase activity in the conditioned and control soils. Results showed that SLES degradation depended on the soil type, with DT50 ranging from 11 to 19 days; the additive increased significantly the surfactant persistence especially in the S2 soil. In the latter case, the highest persistence of the product can be ascribable to the detrimental effect of the additive on the microbial abundance and activity.

**WO034** Application of the Vibrio fischeri acute toxicity test to assess the environmental impact of spoil materials containing foaming agents


The rapid development of TBMs in the tunnelling industry has been mainly due to conditions, reduced damage at surface level and higher productivity. In accordance with the Italian legislation, spoil material from excavation processes can be re-used as by-products if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C>12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its ecotoxicological effects on soil and water organisms. The use of ecotoxicological tests makes it possible to overcome the analytical limits to detect multicomponent commercial foaming products (of which the complete composition is often unknown), to save time by avoiding the designing of new analytical methods for the increasing number of chemicals used in new foaming formulations continuously being put on the market. Above all, they provide information about the different interactions between the mixture and the specific matrix and the possible ecotoxicological effects on biota. In several studies devoted to evaluate the potential impact of spoil materials the bacterium Vibrio fischeri should be very sensitive to the residual concentrations of the surfactant SLES in eluates obtained from soil samples collected from excavation sites. The overall analysis of a set of chemical and ecotoxicological data showed that the bioluminescence inhibition was directly related to SLES concentration. Consequently, the ISO 11348-3:2007 test is a suitable tool to assess in a short time the occurrence of foaming agent residuals at effect concentrations in spoil material.

**WO035** Biodegradability of the anionic surfactant sodium lauryl ether sulphate used as the main component in two foaming agents for tunnelling process


The anionic surfactant sodium lauryl ether sulphate (SLES) is the main component of most commercial products used for soil conditioning in the excavation industry, in particular as lubricants for mechanized tunnelling. This excavation process produces a large amount of spoil materials that can have a potential impact on ecosystems. The lack of accurate information about SLES persistence in the environment has aroused increasing concern for their possible recycling as construction materials or as soil replacement for covering rocky areas. Currently, there are neither SLES soil threshold limits in European legislation, nor comprehensive studies on the environmental risk for soil ecosystems in these exposure scenarios. The objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents (P1, P2). For this purpose, a set of microcosms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) from the construction site. Microcosm experiments were set-up with soil samples conditioned separately with the foaming agent P1 (85 mg/kg SLES concentration) or P2 (83 mg/kg SLES concentration). Some soil samples were previously sterilized in order to evaluate abiotic degradation in absence of the microbial community. Moreover, control microcosms, consisting of un-treated soil, were also present in order to compare the microbial community before and after the foaming agent addition. At selected times (0, 7, 14, 21, 28) soil samples were collected for assessing SLES concentration by AEX extraction followed by MBAS spectrophotometric method. Microbiological analyses were performed in order to assess microbial abundance, cell viability (Live/Dead method), dehydrogenase activity and the phylogenetic structure of the microbial community by the Fluorescent In Situ Hybridization (FISH) method. Although an initial negative effect on microbial abundance and viability was observed, at the end of the experiment SLES was no longer present in all soils and no significant differences between the different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) were observed. Dehydrogenase activity and cell viability were comparable between treated and control soil. SLES was completely biodegraded at day 28 and a shift in the microbial community was observed comparing the control vs treated soils. In particular, a significant increase in the Gamma-Proteobacteria group, which includes bacteria able to transform SLES, has been found.

**WO036** Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line

M. Cardoni, National Research Council of Italy / Water Research Institute; P. Grenni, National Research Council of Italy (CNR) / Water Research Institute; A. Barra Caraciolo, National Research Council / Water Research Institute


The Polyfoamer ECO line of commercial products, designed as by-products from the surfactant industry, aims to be a suitable alternative to current products used for soil conditioning in the excavation industry. The Polyfoamer ECO line consists of two main components: the sodium lauryl ether sulphate (SLES) contained as the main component of most commercial products used for soil conditioning in the excavation industry, in particular as lubricants for mechanized tunnelling. This excavation process produces a large amount of spoil materials that can have a potential impact on ecosystems. The lack of accurate information about SLES persistence in the environment has aroused increasing concern for their possible recycling as construction materials or as soil replacement for covering rocky areas. Currently, there are neither SLES soil threshold limits in European legislation, nor comprehensive studies on the environmental risk for soil ecosystems in these exposure scenarios. The objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents (P1, P2). For this purpose, a set of microcosms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) from the construction site. Microcosm experiments were set-up with soil samples conditioned separately with the foaming agents P1 (85 mg/kg SLES concentration) or P2 (83 mg/kg SLES concentration). Some soil samples were previously sterilized in order to evaluate abiotic degradation in absence of the microbial community. Moreover, control microcosms, consisting of un-treated soil, were also present in order to compare the microbial community before and after the foaming agent addition. At selected times (0, 7, 14, 21, 28) soil samples were collected for assessing SLES concentration by AEX extraction followed by MBAS spectrophotometric method. Microbiological analyses were performed in order to assess microbial abundance, cell viability (Live/Dead method), dehydrogenase activity and the phylogenetic structure of the microbial community by the Fluorescent In Situ Hybridization (FISH) method. Although an initial negative effect on microbial abundance and viability was observed, at the end of the experiment SLES was no longer present in all soils and no significant differences between the different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) were observed. Dehydrogenase activity and cell viability were comparable between treated and control soil. SLES was completely biodegraded at day 28 and a shift in the microbial community was observed comparing the control vs treated soils. In particular, a significant increase in the Gamma-Proteobacteria group, which includes bacteria able to transform SLES, has been found.

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geological formation with alternation of limestone and marlstone) and the material called “S” (a cohesive clay). The amount of the surfactants inside the conditioned samples "S" and "M" have been measured with the instrument HPLC-MS ("High-Performance Liquid Chromatography Mass") at different stages from the addition of the foam to the soil: at time 0, at 3 and at 7 days. Toxicity tests with the bio-luminescent bacteria Vibrio Fischeri (ISO 11348:2007) and the fish embryo Diaphanosoma magna (OECD 206) have been carried out. As a consequence of environmental tests with the new foaming agents Polyfoamer ECO confirm that the new formulations allow to reduce the impact on the soil and therefore to facilitate its re-use in short periods as a by-products. The main results obtained with the Polyfoamer ECO/100 and Polyfoamer ECO/100 Plus are: lower toxicity and lower content of organic material when compared to traditional foaming agents, fast decomposition of the surfactants inside the conditioned soil, low toxicity of the conditioned soils and tendency of toxicity decrease along the time. Values comparable to the natural soil toxicity are achieved in a short period.

Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) followed by the modified Methylene Blue Active Substances (MBAS) method in spoil material from excavation processes


Recent years have been characterized by a rapid worldwide growth in underground constructions in the form of new infrastructures such as pipelines and communication cables as well as road and railway tunnels. The utilization of underground space offers a new strategy to urban planning, including a huge development of the mechanized tunnelling industry by the use of Tunnel Boring Machines (TBMs). Polyfoamer C-S is a trademark of TMB, a proprietary formulation of appropriate soil conditioning products, primarily foaming agents. Anionic surfactants are the main constituents of commercial foaming agents widely used as lubricating products in the mechanized excavation, improving the stability of the excavation face and reducing the friction between soil cuttings. Among the anionic surfactants, sodium lauryl ether sulphate (SLES) is the most utilised compound in the commercial products for the excavation industry. Significant amounts of rock broken into various sizes mixed with anionic surfactants are produced during the execution of engineering works. The potential re-use of this non-renewable natural resource, for example as land covering, depends on the assessment of its environmental compatibility; otherwise, the spoil materials must be treated as a waste. In this context, it is important to evaluate the residual concentrations of SLES in the excavated soils in order to evaluate their possible final destination. Given the absence of official analytical methods, it has become necessary to develop and validate a reliable and accurate methodology to quantify anionic surfactants in the spoil materials and, more in general, in the environmental solid matrices. For this purpose, the aim of the present work was the optimization of an analytical method for the determination of SLES in conditioned-soil samples. It consists of a first phase of extraction of anionic surfactants from the soil by the use of Pressurized Liquid Extraction (PLE) and the following analysis in the extract by the MBAS (Methylene Blue Active Substances) method using the water official method partially modified. The optimised method has been applied to real excavated soil samples because the determination of residual concentrations of the anionic surfactants in the spoil materials produced during excavation process, is currently one of the mandatory parameters for assessing their eco-compatibility.

Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study for EPB-TMB applications


The development of the mechanized tunnelling industry by EPB-TBMs (Earth Pressure Balance - Tunnel Boring Machines), results in a wide use of foaming agents and polymers as lubricating products for soil conditioning. Anionic surfactants, and in particular sodium lauryl ether sulphate (SLES), are components of foaming commercial products. Soil debris from excavation processes can contain residual concentration of SLES. The potential re-use of the spoil material for public green areas or industrial purpose (e.g. land covering) depends on the site-specific SLES persistence in the excavated soil and on the related environmental exposure scenario. In this context, we evaluated the SLES leaching in different soils in order to simulate check whether underground water contamination may occur in a scenario where the spoil material is located close to a water body. For this purpose, we evaluated the persistence (DT₅₀) of SLES in two soils (S1: silty-clay soil; S2: gravel in a clay-sandy matrix soil) conditioned separately with two common commercial foaming agents, respectively F1 and F2, used at conditioning ratio giving final concentration in both the soils of about 150 mg/kg. The presence of strengthening foaming polymers (P1 or P2, 527 and 50 mg/kg respectively), needed in some cases to increase foam persistence, was also considered. After a preliminary phase at laboratory scale, a mesocosm experiment was conducted in order to entail the scale-effect, which is very significant when the soils are involved. SLES solutions were set-up mixing 100 kg of each soil with water, foam and polymer and then stored for 28 days in high-density polyethylene bins (HDPE diameter of 30 cm and height of 100 cm). The effect of soil type, grain size or aeration on SLES persistence was evaluated. For this purpose, eight bins containing S1 or S2 conditioned separately with the two foaming agents, were weekly turned to improve aeration, while the corresponding eight blends were not turned. At selected times (0, 4, 7, 12, 20 and 28 days), soil and leachate samples were collected from the bins for assessing SLES concentration by MBAS spectrophotometric method, preceded by ASE (Accelerated Solvent Extraction) in the case of the soil matrix. The results showed that residual SLES concentration in soil and in leachate is dependent both on the type of soil and on the nature of polymers.

Preliminary environmental risk assessment of sodium lauryl ether sulphate contained in foaming agents used in mechanized tunnelling


Among ANS, the sodium lauryl ether sulphate (SLES) is commonly utilized as a foaming agent to facilitate the excavation procedures in mechanized tunnelling. However, its use raises concerns for the environment considering the presence of SLES residues in soil debris produced during the excavation. In addition, the absence of soil threshold limit for SLES in the EU legislation does not facilitate the re-use of soil debris as by products (e.g. land covering) and, consequently, a huge amount of such detritus can be discharged as a waste with high economic costs. In absence of a threshold limit, performing an environmental risk assessment (ERA) of foaming agents containing SLES can be a possible alternative. However, the ERA is hampered by both the rather scarce data on the effects of SLES and the site specific condition of use which lead to different levels of exposure. Indeed, the selection of the type and quantity of foaming agents depends on soil, geological conditions, and characteristics of the tunnel boring machines. Furthermore, several commercial formulations are available on the market with different percentages of SLES and several other components. This study is part of a wider project aiming to develop a methodology to be applied to identify environmental acceptable levels of SLES residues in soil debris produced during the tunnelling operations in Italy. Particularly, we report the results regarding the preliminary ERA that has been used to select, among all the available commercial formulations, the one leading the lowest level of risk for the environment in a specific condition of use. The risk has been characterized based on PEC/PNEC ratios. PECs were calculated by predictive models and considering the percentage of SLES in the commercial formulations as well as the required treatment ratios for tunnelling operations. PNECs (soil and surface water) for SLES were derived from ecotoxicological data (terrestrial and aquatic organisms) which were obtained from laboratory tests on several test organisms.
agent products are anionic surfactants such as the alkyl ether sulfates (AES). The possible re-use of huge amounts of spoil material produced during the excavation process as by-products (e.g. land covering) or its discharge as a waste depends on the residual concentration of AES in the soil. The first option has the undoubted advantage to lower the costs of disposal. However, there are concerns about the potential environmental risk related to the re-use of conditioned soil. In fact, even if anionic surfactants are generally considered biodegradable and not toxic, there is little information in literature on their environmental fate and the possible ecotoxicological effects of the commercial formulations of foaming products and of the conditioned soils. The aim of this study was to evaluate the environmental compatibility and the ecotoxicological effects of two different soils treated with two different foaming agents containing the anionic surfactant AES, applying a suitable battery of bioassays. For this purpose, a soil polyvalent prepared, containing two soils with different geopedological characteristics, conditioned with two foaming agents at the same treatment ratios (TR, L/m^3) used for mechanized drills. Soil samples were collected at different maturation times (0, 7, 14, 28 days) in order to perform the ecotoxicological tests on the spoil material or in its aqueous extracts. The bioassays selected are representative of different trophic levels for the aquatic and terrestrial compartments: Microtox test with the bacterium Vibrio fischeri; Fish Embryo Acute Toxicity Test (FET) with the species Danio rerio, germination and growth test with the plant Lepidium sativum and test with the worm Eisenia fetida. In parallel, sub-samples of soil and elutriate from each mesocosm were analyzed in order to determine the residual concentrations of the anionic surfactant AES. The overall results obtained showed different ecotoxicological response depending both on the kind of condition and on the evaluated tests (i.e. the soil showed different toxicity responses). The study highlights the importance of a site-specific ecotoxicological evaluation in the tunneling projects in order to have a real environmental compatibility of the spoil material.

**WE041**

**Expedient site test for on-site monitoring activity in mechanized tunneling applications**


In the vast majority of tunnel projects performed with TBM (Tunnel Boring Machines) technology a key issue is currently represented by the disposal management of the spoil, huge amount of excavated material mainly composed by the natural soil, water and chemical instability originating from the process. There is a need to plan strategies for spoil disposal management in a virtuous cycle of reuse of the resources leading to relevant economical and logistical advantages. The raising awareness about the chemical composition of the products injected during the excavation resulted in the development of experimental procedures aimed at studying the environmental impact of chemicals and their permanence in the soil during the excavation and after the spoil disposal. Recently, computational studies have been developed in order to evaluate the effect of specific concentration values of these chemicals on terrestrial and aquatic environments, as well as to measure the reduction of the concentration of these compounds in each environment due to the action of the микроorganisms inhabiting them. All these experimental procedures must be carried out in specialized laboratories equipped with sophisticated apparatuses, in which controlled environments are predisposed, so that at present it’s not possible to measure the level of pollution through expeditious tests directly on site. A joint research activity between Sapienza University and National Research Council of Rome has developed a test procedure able to provide expeditious information on the presence in the spoil of the chemicals often used in mechanized tunneling. The results of preliminary laboratory tests convinced that the expeditious assessment proposed can describe the amount of chemicals in the soil and their evolution in time, complementing the laboratory activities currently accepted. In fact, this fast test procedure can be regarded as a first screening which can be run directly in site on a large number of samples without the use of expensive, delicate or complex instruments, to be used in combination with few more precise laboratory tests. Moreover, this test seems to be particularly suitable for monitoring large volumes of spoil involved in tunnel excavation. The intention for the future is to apply the procedure to real cases to verify, through a comparison with the most accurate laboratory tests, the actual effectiveness of this procedure.

**WE042**

**Toxicity of several additives used in mechanized tunneling: effects on daphnids, algae and cress.**

D. Baderna, S. Maiorana, A. Passoni, R. Bagnati, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; M. Lodi, E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

Surfactants and polymers are used in mechanized tunneling to facilitate the excavation and to preserve the tunnel boring machine (TBM) from wear, block and break. As a by-product of the process, several tons of rocky debris are produced. These excavation rocks are made of rock fragments contaminated by the additives such as anionic surfactants, glycols, sealants, polyacrylates and polyacrylamides. In the past, rocky debris were disposed as waste with a large economic impact on total excavation cost, while some disposal alternatives were recently applied, trying to recycle these complex materials as road filling material, covering rocky areas or river banks. These disposal solutions, however, have attracted the attention of regulators and environmental protection agencies, especially in Italy. In fact, the toxicology of these active mixtures is not yet fully known as well as the potential effects deriving from the simultaneous presence of additives with other regulated environmental contaminants such as, for example, metals and hydrocarbons. A preliminary study recently conducted by our group on three commercial TBM additives showed toxic effects on the aquatic ecosystem in concentrations comparable to those resulting from excavations carried out in Italy. This new study analyses 8 surfactants and 4 commercial polymers, using a multidisciplinary approach to determine their reference thresholds for both water and soils, accounting of the effects on ecological targets. The chemical composition of the technical mixtures was determined by liquid chromatography coupled with high resolution mass spectrometry. The main chemical components were analyzed in silico to highlight the potential similarity with other pollutants, already listed in our environmental framework regulation. Finally, the toxicity of the various agents has been evaluated by tests with Daphnia magna, freshwater algae and cress. Chemical characterization identified 15 molecules present in all the surfactant mixtures, although in different proportion. No similarities with compounds already regulated by the Italian Environmental Act were found by the in silico analysis. All the tested surfactants were toxic for the aquatic organisms at concentrations comparable to those that can be found in leachates of conditioned rock debris. The additives resulted non toxic for the terrestrial plant at concentrations theoretically found in conditioned rock debris.

**PBt/PvP & PMT/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (P)**

**WE043**

**Bioaccumulation, tissue distribution, and trophic magnification of organic ultraviolet absorbents in freshwater ecosystem in the Pearl River catchment, China**

A. Peng, Z. Zhu, S. Xiong, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

Bioaccumulation and trophic transfer of organic ultraviolet absorbents (UVAs) were investigated in riverine wildlife organisms in the Pearl River catchment, South China. The UVAs were widely present in the fish with the highest level detected for UV 531. Generally, the UVAs concentrations were higher in the freshwater fish than in shrimp. Dietary habits of the fish showed effects on bioaccumulation of the UVAs with higher levels in the carnivorous species than in the herbivorous, planktivorous and detritus feeding fishes. Tissue distributions were generally in the order of liver > belly fat > muscle. Obviously higher concentrations of 2-ethylhexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (LogBAF)were usually > 3.3, suggesting potential of the UVAs in the freshwater fish. UV 531 showed tendency of bioaccumulation in the fish from the sediment indicated by the calculated BSFA >1. The estimated trophic magnification factors were >1 for some benzotriazole stabilizers, suggesting potential of biomagnification of the UVAs in the freshwater fish.

**WE044**

**Hyalella azteca as non-vertebrate alternative species for bioaccumulation studies**

M. Håbekost, BASF Corporation; N. Kreling, BASF SE / Crop Protection - Ecotoxicology; B. Kusebauch, M. Obermann, BASF SE Agrarzentrum Limburgerhof

Bioaccumulation is one of the PBT (persistence, bioaccumulation, toxicity) cut-off criteria for plant protection products (EC/1107/2009) in the EU; furthermore, high bioaccumulation is generally considered a critical parameter in other regions, too. The standard regulatory assessment of bioaccumulation is based on bioconcentration in aquatic species, i.e. for regulatory purposes in fish. However, standard fish bioaccumulation studies are time consuming, expensive and they use a considerable number of experimental animals. There is a need for a relatively quick, cheap, and preferably alternative test method that enables the ranking of structurally clustered candidate molecules regarding bioaccumulation potential and the prediction whether a candidate molecule will exceed the BCF (bioconcentration factor) trigger value. Furthermore, Hyalella azteca might in the long-term perspective be able to replace fish for BCF testing. There is indication that experimentally determined BCF values for fish are often lower than bioaccumulation studies with Hyalella are similar to those obtained from fish (Schlechtriem, 2012). Further work is presented in order to (i) increase the data base of Hyalella – fish BCF data sets covering a wide range of BCF values (i.e. 100 to 20000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges.
Bioaccumulation of ionizable organic chemicals in fish - The quest for reliable predictors

F. Poulsen, Technical University of Denmark (DTU) / DTU Environment; Z. Zhang, Technical University of Denmark / DTU / DTU Environment; K. Bittermann, Helmholtz Centre for Environmental Research GmbH - UFZ / Analytical Environmental Chemistry; I. Linden, UFZ / Helmholtz Centre for Environmental Research / Department of Analytical Environmental Chemistry; C. Schlechtliem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; K. Große, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry; S. Trapp, Technical University of Denmark / DTU / DTU Environment

Bioaccumulation in fish is quantified using biomagnification factors (BMFs), which are derived under controlled conditions according to OECD guideline 305-III. To reduce in vivo experimental efforts, pre-screening using statistical models for BMF predictions is becoming increasingly popular. While dietary bioaccumulation of neutral chemicals has been successfully associated to lipophilicity descriptors, no suitable predictor has yet been identified for ionizable chemicals. In this study, we investigated the capability of selected chemical properties (e.g., molar volume, adsorption to albumin, lipophilicity, solubility, topological polar surface area) to predict bioaccumulation of organic electrolytes in fish with specific focus on dietary exposure studies. Measured dietary BMFs were collected from existing literature, and empirical correlations with measured or estimated chemical descriptors were evaluated. The dataset includes dietary BMFs in whole fish obtained under laboratory-scale conditions closely resembling or directly referring to the OECD 305-III guideline. In total, BMF data were available for 29 ionizable chemicals (of which 10 are perfluorinated chemicals); including 24 acids and 5 permanently ionized chemicals at environmental pH (range 3 to 9). A parallel dataset was compiled with bioconcentration factors (BCFs) of the same chemicals derived in water exposure studies with fish (OECD 305-1 guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a logKOW was not a sufficient predictor of BMF, although with significant positive correlation (R=0.40), and b) that significant correlation was shown only with logKOW at pH=3 (R=0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R < -0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., logKOW) are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BCf from quantum-chromodynamics-based estimations of partitioning coefficients (to measure lipophilic interactions). Estimation of BCFs from BMF for the investigated chemicals will be also performed and verified with existing BCF measurements. Eventually, identified empirical regressions between BMF and chemical descriptors will be validated with ad hoc experimental data with radio-labelled test chemicals.

Evaluation of a tiered approach for the bioaccumulation assessment of fragrance substances: in silico, in vitro assays, invertebrate vs. in vivo fish bioconcentration test

S. Gimeno, Firmenich / Product Safety and Regulatory Affairs; V. Laubscher, F. Berthaud, Firmenich SA / DRAS; J. Bischof, Fraunhofer Institute for Molecular Biology and Applied Ecology IME / Department Bioaccumulation and Animal Metabolism; M. Schuh, Fraunhofer IME / Department Bioaccummulation and Animal Metabolism; C. Kroepf, University of Bern / Centre for Fish an Wildlife Health; H. Segner, University of Bern / Centre for Fish and Wildlife Health; H. Schug, Eawag Swiss Federal Institute of Aquatic Science and Technology; K. Schirmer, Eawag / Environmental Toxicology; F. Begnud, Firmenich / DRAP

Bioaccumulation is a key end point in environmental hazard and risk assessment, especially for substances with a high octanol water partition coefficient (logKOW). To measure the BioConcentration Factor (BCF), a tiered approach is followed starting from the assessment of the octanol water partitioning coefficient as a measure for lipophilicity, which is often used as surrogate for lipid partitioning up to an experimental BCF value which is considered as the gold standard for fish bioaccumulation assessment. We have applied a series of non-animal tests to predict the BCF values and compared those outcomes to the results from a BCF test in order to validate this alternative approach. Several fragrances from the tetranolactone diterpenoids family, either composed of a single or a mixture of stereoisomers were tested. The logKOW predicted by QSAR ranges from 4.75-5.41 and 4.2 when determined by HPLC (OECD 117). The slow stir method (OECD 123) provides a logKOW of 5.09 which is retained as the reference value. Various structure-activity relationship models were used to predict the fish bioconcentration factor, which ranged from ~1000 to ~4500, not exceeding the EU criteria for (very) Bioaccumulative substances (vB), however, the structure was mostly outside the applicability domain of the models. Therefore in vitro assays were conducted on rainbow trout S9 fractions and hepatocytes confirming the potential of this biotransformation; the refined BCF values calculated with IVIVE extrapolation models were <1000. In addition the bioaccumulation potential of one isomer was investigated in a flow-through test on the invertebrate Hyalella azteca resulting in a BCF50 or kinetic <500 L/kg. Finally an experimental fish BCF of ~500 (OECD 305) confirms that the fragrance composed of various isomers is not bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.

Proposal for a freshwater trophic magnification study based on a Comprehensive literature evaluation


Bioaccumulation potential is a critical property used for the risk assessment of chemicals and is usually expressed by parameters derived from laboratory or field experiments, in particular bioconcentration-, bioaccumulation- and biomagnification factors. A relatively new approach is the determination of so-called trophic magnification factors (TMF) which integrate enrichment processes of a chemical over several trophic levels. TMF's may be used in different scenarios such as food web studies or as a basis for regulatory usage of this endpoint. The developed concept focuses on freshwater habitats, covers different invertebrate and fish species and will be tested in a proof of concept study. A water body will be selected under consideration of several aspects such as the chemical burden of the water body, the type of contamination source, and species diversity in the water body. Invertebrate and fish species will be collected in the water body during summer/summer 2018. The trophic levels of the species will be determined applying different methods such as comparison of stable isotope patterns in the case of terrestrial and aquatic species (carbon and nitrogen). The end points have yet been performed and the investigated endpoints have shown considerable variation. The aim of this study is to define a sound concept for TMF investigations to enhance both, the reproducibility and accuracy of TMF estimates to allow the regulatory usage of this endpoint. The developed concept focuses on freshwater habitats, covers different invertebrate and fish species and will be tested in a proof of concept study. A water body will be selected under consideration of several aspects such as the chemical burden of the water body, the type of contamination source, and species diversity in the water body. Invertebrate and fish species will be collected in the water body during summer/summer 2018. The trophic levels of the species will be determined applying different methods such as comparison of stable isotope patterns in the case of terrestrial and aquatic species (carbon and nitrogen). The end points have yet been performed and the investigated endpoints have shown considerable variation. The aim of this study is to define a sound concept for TMF investigations to enhance both, the reproducibility and accuracy of TMF estimates to allow the regulatory usage of this endpoint. The developed concept focuses on freshwater habitats, covers different invertebrate and fish species and will be tested in a proof of concept study. A water body will be selected under consideration of several aspects such as the chemical burden of the water body, the type of contamination source, and species diversity in the water body. Invertebrate and fish species will be collected in the water body during summer/summer 2018. The trophic levels of the species will be determined applying different methods such as comparison of stable isotope patterns in the case of terrestrial and aquatic species (carbon and nitrogen). The end points have yet been performed and the investigated endpoints have shown considerable variation. The aim of this study is to define a sound concept for TMF investigations to enhance both, the reproducibility and accuracy of TMF estimates.
analysis
S. Gabbert, Wageningen University / Social Sciences; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; M. Nendza, Analytisches Laboratorium – K. Thiele, WUR; S. Gabbert, Wageningen University / Social Science

In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their environmental properties. This implies a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazardous and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may therefore be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE049
PBT/vPvBs: All equally bad or some worse than others? - How to inform risk management
K. Thiele, WUR; S. Gabbert, Wageningen University / Social Science

In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their environmental properties. This implies a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazardous and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may therefore be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE050
Modelling Persistent & Mobile Organic Compounds using an updated Multimedia Urban Model: A Toronto Case Study with Organophosphate Ester (OPEs)
T.J. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; L. Jantunen, Environment and Climate Change Canada; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; M.L. Diamond, University of Toronto / Department of Earth Sciences

Organophosphate Esters (OPEs) are a group of chemicals found at relatively high levels in the environment, particularly in the atmosphere. The usage of these chemicals has increased in recent years following the listing of penta- and octa-BDEs as POPs under the Stockholm Convention. In contrast with BDEs, OPEs highly polar molecules which can be considered persistent and mobile organic compounds (POMOCs). We modified the Multimedia Urban Model (MUM) of Diamond and co-workers by using a polynomial parameterization of free energy relationships (ppFERs) to represent partitioning, and it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE052
Polymers: The Next Frontier in Environmental Hazard Assessment
A. Carras, Kao USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Coleman II, Kao

Polymers are a very large and diverse class of chemicals widely used in cosmetic and personal care products. Their use and function are essential in creating high performing products that meet the needs of consumers. As used in cosmetic formulations, polymers can act as thickeners, emulsifiers, conditioners, opacifiers, film formers, rheology modifiers, etc. In the simplest terms, according to the Oxford Dictionary, a polymer is a “substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together.” They have a full range of physical-chemical properties including a wide breadth of solubility and molecular charge, for example. Currently, the majority of large molecular weight polymers are exempt from chemical regulations around the world (e.g. REACH) or are largely considered of low concern based on a minimum set of physical-chemical properties (e.g. low volatility, high water solubility). However, there is a speculation that these regulatory exemptions, specifically the REACH exemption, could be removed in the next 5-10 years. If this is the case, many previously untested chemicals would then need an environmental hazard assessment supported by an ecotoxicological dataset. This dataset may include aquatic toxicity testing, read-across to structurally similar chemicals that have been tested, weight of evidence toxicity estimates based on physical-chemical properties, or all of the above. However, the same variety of physical-chemical properties that allows polymers to have so many functional characteristics that have a molecular structure consisting chiefly or entirely of a large number of similar units bonded together. Therefore, they have a full range of physical-chemical properties including a wide breadth of solubility and molecular charge, for example.
requirements, strategies and challenges. Abstract A PBT substance is one that is persistent (P), bioaccumulative (B) and toxic (T) or very persistent (vP) and very bioaccumulative (vB). The PBT assessment approach is well described under the REACH regulation (Regulation EC No 1907/2006) starting with a screening assessment based on available data and when a potential PBT is identified, then a definitive assessment is required. While this procedure is clearly understood for industrial chemicals, it is less clear for pharmaceuticals, which are different from other substances. There is no definitive PBT/vPvB guidance for pharmaceuticals, from the European Medicines Agency (EMA), although it is recommended that the assessment be made according to REACH criteria. Application of the REACH guidance to the PBT assessment of pharmaceuticals is not straightforward. A PBT evaluation of a substance is triggered within REACH if more than 10 tonnes of the substance is used per year. There is no established trigger value for performing a PBT assessment for pharmaceutical products, although it appears that a PBT assessment is applicable to pharmaceutical products that go into Phase II. However our experience is that there is room for interpretations during the review process – especially for products that end at Phase I. Some RMS have consistently rejected the use of all available data; especially data derived from QSARs and instead treat the product as non-PBT. Furthermore, the criteria for the PBT assessment of ionic substances are governed by the EU regulation REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) (EU Nr. 1907/2006), which can be interpreted as a non-PBT if the charge of a non-charged functional group will be involved in a specific behaviour of 14C-labelled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonic acid sodium salt and 4-4-Dodecylbenzyltrimethylammonium chloride in soil simulation tests (OECD 307) will be investigated according to their mineralized, extractable and non-extractable fraction. Non-extractable residues will be investigated further. In addition, the sorption behaviour of the model substances will be determined in a sorption study (OECD 106). The results will enable the estimation of the effect of the positive and negative charged groups within the molecule structure regarding the biodegradability and will improve the evaluation of the persistence of ionic and insoluble substances in the PBT-assessment.

WE065 Interaction of sulfonamide with soil humic acid: ESR investigations with nitroxide spin label A. Ricke, E. Bondarenko, H. Steinhoff, University of Osnabrueck / Physics; G. Ür, K. Hideg, T. Kaiä, University of Pécs / Organic and Medicinal Chemistry; M. Matthies, University of Osnabrueck / Institute of Environmental Research. Studies of HO• (‘super spin’ or HO-4888) and its acetyl derivative HO•-4917. The labeling at the pyrimidine moiety of SDZ leaves the aniline moiety susceptible to covalent binding to LHA, which is blocked by the N-acetylation. A broadened ESR signal was observed for HO-4888, which indicates strong restriction of the reorientational motion of the spin probe, i.e. immobilization due covalent binding of the aniline moiety of SDZ to reactive quinone sites of LHA. This signal increased immediately after incubation and was used to determine the first-order reaction kinetics of the covalent bond formation. A fast reaction with a half-life of 0.108 h and a slower reaction with a half-life of 14.9 h of covalent binding as well as a reduction half-life of 642 h for the unpaired electron were determined. The treatment of LHA with laccase corroborates the covalent bond formation by oxidizing non-reactive hydroquinone to reactive quinone moieties, which could react via a nucophilic addition with the amine group of HO-4888. A broadened ESR signal was also recorded for HO-4917 immediately after incubation with LHA. However, this signal declines in contrast to the increase of the signal of HO-4888. This immobilization is caused by unspecific sorption to LHA, not by covalent binding, which is blocked by the N-acetylation. The decrease is attributed to the reduction of the nitroso spin label and has a half-life of 98.4 h. In a further experiment with the antioxidant Na-ascorbat the reactivity of non-charged SDSZ was found to be identical demonstrating that SDSZ are probably not physically entrapped, at least with soil humic acids.

WE057 The role of non-extractable residues in the environmental risk assessment from regulatory perspective - requirements and challenges A. Wiemann, UBA Umweltbundesamt; J. Hogeback, Federal Institute of Hydrology; G. Speichert, German Environment Agency UBA; D. Gildemeister, Umweltbundesamt / German Environment Agency / IV2.2 Pharmaceuticals; D. Löffler, T. Ternes, German Federal Institute of Hydrology. The role of non-extractable residues in regulatory frameworks is different in different regulatory frameworks. In some cases NER are integrated in the calculation of predicted environmental concentrations (PEC) or are an issue in the authorisation decision. The significance of NER in the assessment of persistence (e.g. PBT, vBvP, POP classification) has been more or less neglected in the past. However, new developments as reflected in guideline revisions (e.g. ECHA R.11, 2017) highlight the importance of NER in toxicity testing and also some NER may be reversibly bound to the soil/sediment and pose a potential risk to the environment or irreversibly bound which can be interpreted as sink. Hence, the potential release of parent or transformation products from NER in soil or sediment should be considered. However, distinguishing between these types of NER presents a challenge up to now. Standardised or commonly accepted extraction schemes or analysis techniques are not available due to the broad range of substances and soil/sediment characteristics. A general classification for NER was proposed by Eschenbach (2013) based on a literature survey dividing NER into four types: type 1 (heavily sorbed fraction) and type 2 (physically entrapped fraction) are
II NER and type I NER should be considered as potentially releasable residues in persistence assessment but the probability of type II release is much lower. For these types the potential of remobilization needs to be tested and evaluated. Our concept is to consider the total amount of NER minus bioNER as the amount of potentially remobilizable xenonNER (type I + II). If a clear differentiation of type I and type II is possible and the latter is irreversibly bound, only type I NER needs to be considered in the persistence assessment. If no characterization of NER is available, we recommend to assess the total amount as potentially remobilizable.

**WE062**

Photodegradation of Atrazine in the Presence of Indole-3-acetic Acid and Natural Montmorillonite Clay Minerals

C. Gu, Nanyang University / School of the Environment; L. Zhang, Nanyang University

In this study, a new natural degradation pathway of atrazine and the potential mechanism are proposed. Atrazine was oxidized under simulated solar irradiation by indole-3-acetic acid at the environmentally relevant concentration under aerobic condition. The reaction was initiated by the production of hydrated electrons generated from the photodissociation of indole-3-acetic acid, and then this species transformed into hydroxyl radical after a series of radical reactions with proton and dissolved oxygen. During this process, the presence of montmorillonite greatly enhanced the yield of hydrated electron and promoted the further degradation of atrazine by hydroxyl radical. The novel reaction is to some extent affected by pH and the type of exchangeable cation present on montmorillonite. Based on our results, a new index of knowledge to extrapolate degradation from laboratory studies to the complex environment. As the first step of our undertaking to develop methodologies to extrapolate laboratory data to the aquatic environment, we chose a fragrance ingredient, Myrrhone® as an example, and used laboratory study results to calculate its photodegradation half-lives at depths in natural waters. Direct photodegradation was revealed to be the dominant photodegradation process of Myrrhone® and the quantum yield was determined to be 0.51 in the laboratory. Four main volatile photodegradation products, which continued to photodegrade, were observed, isolated by preparative multidimensional GC and identified using NMR. Direct photodegradation half-lives of Myrrhone® in natural waters at different depths were calculated based on its molar absorption spectrum, quantum yield, and the irradiance at depth of natural waters. The irradiance values at depth were obtained by applying diffuse attenuation coefficients (Kd) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, obtained by applying diffuse attenuation to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, obtained by applying diffuse attenuation coefficients (Kd) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, obtained by applying diffuse attenuation coefficients (Kd) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, obtained by applying diffuse attenuation coefficients (Kd) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time. Kd is empirically determined by the interaction of a number of factors, including absorbance by dissolved organic matter and particulate matter, scattering, and the angular distribution of the light field. A correction factor for each component was used to calculate each component independently of each other...this seems unrealistic in most cases. Incorporation of a radiolabel to this test is likely to be prohibitive in terms of scale. An alternative approach would be to consider the chemical structures in a UVCB in groups and to test exemplar molecules or structures from within the mixture. This approach is possible when the individual structures have similar physico-chemical properties and structures are related. In this case UVCB data is provided for the exemplar which can be used to predict the overall persistence of the UVCB substance. Choosing the most appropriate exemplar molecule may be challenging and examples are given. If the exemplar molecule is persistent then reasoned logic would dictate that the UVCB substance was persistent and further testing implemented accordingly.

**WE066**

In silico investigation of the triplet-sensitised phototransformation of phenols induced by chromophoric dissolved organic matter

E. Papa, University of Insubria / Department of Theoretical and Applied Sciences (DISTA); L. Monta, University of Insubria / Department of Theoretical and Applied Sciences (DISTA); A. Sangion, P. Grammatica, University of Insubria / Department of Theoretical and Applied Sciences (DISTA); M. Minella, D. Vione, University of Torino / Chemistry

Chemical reactions driven by sunlight are important processes in surface freshwaters, where they are involved in the transformation of xenobiotic molecules and of naturally occurring compounds. The relevant reactions are generally divided into direct photoreactions, photolysis and phototransformation. Direct photolysis involves molecules that absorb sunlight and are transformed as a consequence. Indirect phototransformation involves reactive transients such as 'OH, CO₂, 'O₂ and the triplet states of chromophoric dissolved organic matter (CDOM*). They are generated by irradiation of photosensitizers such as CDOM (producing 'CDOM, 'O₂ and 'OH), nitrate and nitrite (producing 'OH). Among these transient species, 'CDOM is certainly the most important one in terms of natural sunlight (which is a consequence of the poorly known nature of CDOM and reactivity). Still, 'CDOM* is involved into the transformation of several organic pollutants. In this work different triplet sensitizers that may be used as surrogates to estimate second-order rate constants with CDOM have been studied in silico. In particular, the experimental second-order reaction rate constants measured for the photodegradation of 49 phenols were employed. For each phenol and for each CDOM proxy (1-nitronaphthalene (1-NN), riboflavin (Rb), 4-carboxybenzophenone (4CBP), and anthraquinone-2-sulfonate (AQS)) have been used to derive Quantitative Structure-Activity Relationships on the basis of theoretical molecular
In this paper solubilization of persistent organic pollutants, PAHs, PCBs, pesticides and emerging pollutants, as PBDEs or PCN, was investigated in water samples, using some anionic, cationic and non-ionic surfactants. These pollutants are well known for their considerable toxicity, persistence and bioaccumulation toward both human health and environment in addition to their low aqueous solubility. However, the use of surfactants to water solution enhances solubilization of hydrophobic organic compounds. Above the critical micelle concentration (CMC), surfactants exist as aggregates in solution and hydrophobic compounds move to hydrophobic micellar core region. This technique was found to be a scavenging method to traditional liquid-liquid extraction with hexane. The physical and chemical properties as size, shape, ionic strength and hydrophobicity are important to identify the appropriate surfactant depending on the type of compound to be removed. The method consists in two steps: a) removal of analytes from aqueous solution by the micelles; and b) clean-up of the organic solvent followed by micellar deformation with addition of NaCl. Both steps are effective, easy and with high recovery of pollutants. Furthermore, the samples are already in the solvent for quantitative analysis. The removal of analytes from aqueous solution was verified by comparing UV-Vis spectra in the range 240-360 nm before and after extraction in isooctane and then, has been quantified with capillary gas chromatography-triple quadrupole mass spectrometry. Results reveal better extraction by micelles than traditional method, mostly more interesting are binary system of surfactants, i.e. cationic-nonionic, anionic-nonionic. It was found that solubilization of analytes increases with increasing hydrophobicity of surfactant. Therefore, the aim of this study is to improve this method comparing solubilization capability of these surfactants based on different number of ethylene oxide units for nonionic surfactants and formaldehyde in cationic surfactants.

Data Gap filling with ECOSAR in K-REACH and the use of QSAR models allows a quick determination of the toxicity levels of chemicals at different confidence limits. However, it is not fully implemented in the data available and the toxicological profile of the chemicals is not always well supported by scientific research. The ECOSAR program, developed by US EPA for the purpose of data gap filling, is used as alternative method to support the assessment of prediction reliabilities. The first topic of concern is the applicability domain. Generally, the applicability domain comprises various aspects. The focus of this presentation is on the mechanistic domain and on the chemical domain in terms of structures and substructures. In particular, the application of atom-centered fragments (ACF) is demonstrated. While ACF characterization of the general structural domain of a training set is established already, the approaches shown here provide more specific information about the reliability of a prediction. On one hand, this is achieved by extending the ACF training set. Furthermore, data sets are separated into subsets with regard to performance or value ranges, and these subsets are employed to derive advanced reliability indicators. Secondly, automatically obtained model selectors can assist in selecting the presumably best-performing model from a model suite for a certain chemical depending on its structure and properties. Model selectors in this regard are computed scores derived from application of the model suite to chemicals with known experimental data. Thirdly, consensus modelling strategies are presented and examined to compensate for individual model errors. When combining predictions from different models, consensus outcomes can accordingly increase the levels of confidence, while conflicting outcomes are indicating lower reliabilities. In this respect, specific indicators have been introduced in silico methods such as consensus, and consensus approaches contribute to weight of evidence assessments. For all three aspects, working tools will be presented, and their performance will be demonstrated via examples from existing models and data sets. Acknowledgment: This study was financially supported by the European Union 7th Framework Program SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.
article 57(f) of REACH based on a demonstrated equivalent level of concern (ELoC) as PBT or vPvB substances. In order to identify PMT as a substance of ELoC it must be demonstrated that there is "scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern" and that there is evidence from a risk based considerations that the substance may cause serious effects during use and after through consideration, it should be demonstrated that the substance on the candidate list is the most effective management strategy. With the protection of drinking water and pristine water bodies in mind, both bioaccumulation and mobility of persistent chemical substances are non-desirable. The environmental effect felt by bioaccumulative and mobile chemical substances varies both temporally and spatially, where mobile compounds can potentially accumulate in semi-closed drinking water cycles, while bioaccumulative compounds are able to accumulate in a closed loop system. vPb can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

**WE072**

How many vPvM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database

R. Holmberg, Danish EPA / Chemicals; E.B. Wedebye, N.G. Nikolov, Technical University of Denmark (DTU) / Division of Diet, Disease Prevention and Toxicology, DTU Food; K. Tyle, DK EPA / Chemicals

USA, Germany, has initiated work to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PMT) substances. Detailed and qualitative methods have been developed using the substance properties of water solubility (Sw) and soil/sediment organic carbon-water partition coefficient (log Koc) by equating log Koc and Sw values based on >64.000 substances. The pH-dependent octanol-water partition coefficient (log Donw) was used as an alternative value for substances which ionize at environmentally relevant pHs. For ecotoxicity, similar QSAR algorithms as used for the ecotoxicity screening under PBT assessments were used. In addition, new algorithms for predicting CMR properties from ongoing work on the updated Advisory Self-classification List (expected to be published by end of 2017 by the Danish EPA) were included to also take potential chronic mammalian toxicity into account. The selected QSAR based T-related algorithms were employed and on the screening algorithms for P and M properties as a screening tool for substances with a potential for mammalian and non-mammalian toxicity to wildlife species and human health. The results of the screenings identify the potentially vPvM and PBT substances currently registered under REACH in tonnages > 10 tpa for manufacturer or importer. The screenings identify substances according to criteria proposed by UBA and the developed QSAR algorithms were also employed to test the vPvM/PMT substance relevant to Capitol management properties. The results provide input for current and future work with the concept of vPvMs/PMTs. The Danish QSAR DB contains 650,543 substances, of which 80,085 currently are pre-registered and/or registered under REACH. Future vPvM/PMT screenings can be refined to address specific substance groups of interest; substances registered after the last REACH registration deadline; or address future modifications, if relevant, in the proposed vPvM/PMT criteria.

**WE073**

Identifying PMT substances amongst REACH registered substances

H. Amy, NGI / Environmental Technology; S. Hale, Norwegian Geotechnical Institute; A. Strüller, denkbares; D. Sättler, UBA / Section IV Chemicals; I. Pampeano from Hydrogeological Subdivision, ITA; G. Santovito, L. Tallantini, University of Padua, Department of Biology; M. Cerr, L. Palmeri, University of Padua / Department of Environmental Engineering; N. Tormen, University of Padua, Department of Biology; S. Valsecchi, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; S. Polesello, Water Research Institute- CNR / Water Research Institute

In 2013 a significant epifauna biomonitoring campaign of surface-water applications has been performed to identify water quality, including some critical uses. A perspective on when and how best to use these products, while at the same time minimizing the environmental footprint will be featured in this Poster Presentation.

**WE075**

LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluorinated acids in Veneto region (Italy)

F. Russo, M. Vazzoler, V. Gruppo, Region Veneto, Direzione Prevenzione, sicurezza alimentare, veterinaria; F. Zanon, F. Da Prà, R. Lava, M. Mazzola, G. Onofrio, L. Da Rugina, ARPA Veneto; M. Bonato, University of Padua, Department of Biology and Department of Chemical Engineering; G. Iari, G. Santovito, L. Tallantini, University of Padua, Department of Biology; M. Cerr, L. Palmeri, University of Padua / Department of Industrial Engineering; N. Tormen, University of Padua, Department of Biology; S. Valsecchi, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; S. Polesello, Water Research Institute- CNR / Water Research Institute

In 2007 two important projects were funded in Veneto region (Italy) to evaluate the run-off impact of short chain fluorotelomer compounds (PFAS) on ground water and drinking water. In the first project, coordinated by the Department of Health Protection, Food and Veterinary Safety of Veneto Region, in association with CNR IRSA, ARPAV and University of Padua, has been proposed and then funded. The activities of the LIFE-Phoenix project, acronym for "Perfluorinated compounds Holistic Environmental Institutional eXperience" started on 2017 and will end in 2020. LIFE PHOENIX project aims to show how a holistic approach to the monitoring, management and control of the environmental system, supported through innovative forecast tools based on ongoing monitoring, can manage risks related to the diffusion of persistent mobile organic contaminants (PMOC) such as short chain PFAS. This project will develop a set of institutional procedures and tools to assess and possibly prevent as well as respond to risks for environment and human health with the contribution of multidisciplinary specialists who will develop tools, protocols, guidelines and indications to assist policy-makers in taking decisions and implementing effective prevention measures for environment, human health and the socio-economic context. All project activities will focus on a real scale case constituted by the PFAS pollution in the provinces of Vicenza, Verona and Padova (an area of 930 km²), and involve authorities managing risks and emergency. The project will validate and compare some innovative technological tools for the mitigation of PFAS concentration in the water through a pilot plant adopting different techniques for the purification of irrigation water and drinking water, using full-scale plant (wetland system) and physico-chemical plans breakdown system (filters). The technologies applied to these experimental sites will be incorporated into an integrated management system that will serve as a model for managing analogous chemical pollution events from persistent and soluble polar substances.

**WE076**

Ecotoxicological characterization of aquifiers at Junin Formation and Pampeano from Hydrogeological Sub-Region II, Buenos Aires Argentina

W.D. Di Marzio, CONICET-PIREET / PRIET; M. Suarez, PRIET CONICET, National University of Luján; J. Alberdi, priet conicet unlu; s. curieses, S. Martinez, CONICET PRIET UNLU; A. Silva, UBA Fac Cs Exactas; D. Galassia, Universita Laquila; T. Di Lorenzo, ISE CNR

The Coatings and Aqueous Film Forming Foams (AFFF) are fluorotelomer-based products used as firefighting foams. Fluorotelomer-based products can be either the polymeric or non-polymeric PFAS categories. Within the polymeric PFAS category, the fluorinated repellent products, including durable water repellents (DWRs), are found. These are normally side-chain fluorinated polymers typically applied in combination with other finishing auxiliaries. The side-chain polymeric fluorotelomer-based products perform exceptionally well and provide oil and water repellent and critical properties on high-end performance garments, workwear, first responder gear and other critical applications. Within the non-polymeric PFAS category, fluorotelomer-based surface active agents (e.g. "fluorosurfactants") are used in complex multi-component formulations such as Cleaning Products, Paints, Coatings and Aqueous Film Forming Foams (AFFF). The non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties and are used as fire fighting agent and as firefighting foam. In this Poster presentation, we will on the fluorotelomer-based products of the PFAS group with six or less fluorinated carbons ("short chain"). Fluorotelomer-based products can be used in the aquatic environment. Each fluorinated bond provides products with superior resistance to extreme thermal, chemical and environmental conditions. While this unique stability makes these products ideal in many end-use applications, as well as in protecting people, equipmen and property, it also makes them resistant to degradation and persistent in the environment. Each of these fluorotelomer-based chemicals (with surface and ground water applications) has the potential to be released during use and could create an environmental footprint. Thus it is essential to follow published best practice guidance (BPG) in handling these products. This poster will highlight recent advances in toxicology, including multiple endocrine evaluations, safer-alternatives assessment methodology, analytical advances, challenges and success in the development of short-chain fluorotelomer-based products and an overview of their value in specific applications. A perspective on when and how best to use these products, while at the same time minimizing the environmental footprint will be featured in this Poster Presentation.

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SETAC Europe 2018 Annual Meeting Abstract Book
The Groundwater of Hydrogeological Sub-Region II at Buenos Aires province is well characterized from a physico-chemical perspective. Until today is well established that fluoride and arsenic are the main concerns related with the potential use as source of drinking water. However, an ecosystemic perspective that focuses on their invertebrate communities and the ecotoxicity potential is missing at least in this subregion. In this work we showed the preliminary results obtained after the sampling and analysis of ten on 20 total wells projected to be evaluated. This area is known as Junín Formation, which consists of sandy and silty sediments to silty clayey of reddish brown to light brown color, very friable, and with scarce calcareous bodies of pedogenic origin. The Junín Formation of wind morphology constitutes an alternation of low elevations and depressions. Aeolian sediments, which belong to the Junín Formation (Aeolian Plateau), normally do not exceed 5 m in thickness and usually have calcareous (coarse) levels. The alluvial and colluvial deposits (sandy silts, sands, gravels and blocks) have a reduced vertical and areal expression. The samples were characterized according to their main anionic and cationic constituents, presence of phosphate and chlorophylls, TOC, arsenic and fluoride. Also, cytotoxicity and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Eiseinia fetida. Water quality was analyzed in combination with the dominant taxon of invertebrates found. They were mainly gray Copepods, Acan, Collombella, Insecta, Oligochaeta, Nematomorpha. A preliminary biotick and ecotopic index were created to characterize each sampling well.

**WE079**

**Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study**

M. Hernández Zamora, Escuela Nacional de Ciencias Biológicas-I.P.N / Laboratory of Experimental Hydrobiology; F. Martínez-Jerónimo, Escuela Nacional de Ciencias Biológicas-I.P.N / Laboratory of Experimental Hydrobiology

Aquatic pollution resulting from industrial activities, especially textile, leather, food and agrochemicals, is a major concern. Dyeing process of fabrics produces approximately 90% of the total textile wastewaters, containing significant concentrations of residual dyes. Colored wastewaters reduce light penetration in the water column, and affect photosynthesis of phytoplanktons. In addition, azo dyes are synthesized from carcinogenic compounds, such as benzidine; this can threat the aquatic biota. The environmental impact caused by the discharge of textile dyes effluents has been scarcely studied; therefore, our study was aimed at evaluating the toxic effect of the azo dye Direct Blue 15 (DB15) on a primary producer (Pseudokirchneriella subcapitata) and on a primary consumer (Ceriodaphnia dubia). The microalgae was exposed to 4, 16, 32 and 64 mg L\(^{-1}\) DB15 (96 h, 25°C, and continuous illumination of 120 μmol m\(^{-2}\) s\(^{-1}\)); the effects of DB15 on photosynthetic pigment and macromolecules content (proteins, carbohydrates and lipids) were assessed. The acute toxic effects of DB15 dye in cladocerans were determined at 48 h; tested concentrations were 100, 200, 300, 400 and 500 mg L\(^{-1}\), at 25°C, 16.8 h photoperiod, with no food supply during the assays. In chronic toxicity tests C. dubia individuals were exposed to 5, 10, 15, 20 and 25 mg L\(^{-1}\) DB15 (7 days at 25°C, 16:8 h photoperiod, 1 x 10\(^{5}\) cell mL\(^{-1}\) of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (IC\(_{50}\), 13.30 mg L\(^{-1}\)) than C. dubia (LC\(_{50}\), 450 mg L\(^{-1}\)) Chlorophyll\(a\) and \(b\) were significantly increased in the algae exposed to all the dye concentrations, comparing with the control, but carotenoids were significantly reduced in all the DB15 concentrations. Concentration of proteins, carbohydrates and lipids per cell in P. subcapitata exposed to all 15 DB15 concentrations were significantly higher than that measured in the control. In the highest DB15 concentrations, total protein, number of released clutches and reproduction were significantly decreased in C. regia); but a decrease at first reproduction was significantly increased at 20 and 25 mg L\(^{-1}\) DB15. Results demonstrated that DB15 dye caused toxic effect of different magnitudes on aquatic biota (primary producer and primary consumer), for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into waterbodies.

**WE080**

**Integrated biomarker response calculation as a useful tool to assess the impact of effluents on the health status of fish**

S. Wilhelm, University of Tuebingen / Animal Physiological Ecology; S. Jacob, Universität Tübingen / Animal Physiological Ecology; M. Ziegler, R. Triebkorn, University of Tuebingen / Animal Physiological Ecology

Wastewater treatment plants (WWTPs) are considered as one of the major sources of micropollutants in the aquatic environment. Many compounds have been linked to toxic and endocrine effects in aquatic organisms. The present study examines the impact of three WWTPs situated on different streams in Southern Germany on the health status of fish. Two WWTPs were treated facilities and one WWTP was investigated in freshwater systems. The alluvial and colluvial deposits of the Junín Formation, which consists of sandy silts, sands, gravels and blocks, have a reduced vertical and areal expression. The samples were characterized according to their main anionic and cationic constituents, presence of phosphate and chlorophylls, TOC, arsenic and fluoride. Also, cytotoxicity and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Eiseinia fetida. Water quality was analyzed in combination with the dominant taxon of invertebrates found. They were mainly gray Copepods, Acan, Collombella, Insecta, Oligochaeta, Nematomorpha. A preliminary biotick and ecotopic index were created to characterize each sampling well.

**WE081**

**Application of eco-genotoxicological and microbiological parameters for the assessment of the quality of wastewater industrial reuse.**

S. Cacioli, Italian Institute of Health ISS / Department of Environmental and
Pharmaceutical residues in sewage effluents pollutes the aquatic environment and may adversely affect fish populations. Conventional sewage treatment plants (STP) are not equipped to efficiently remove pharmaceuticals. Ozonation is emerging as a method to improve sewage treatment. Ozonation can however potentially create toxic by-products (OBP) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP with a full scale pilot ozonation unit investigating endocrine, neurobehavioral and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₂ L⁻¹). We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 day/night cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformations and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent fortified with organic and a nitrogen compound in feed altered the biological activity. A second study related to behavioral effects was recorded in the adult fish exposed to the ozonated effluent. No adverse effects on the fish progeny was noted. Whether these biological effects would have an adverse impact on the population level remains speculative. Ozonation is a capable method for removing pharmaceutical residues from sewage effluents. Yet its implementation should be carefully monitored in order to minimize undesirable side-effects.

**WE083**

**Increased ozoneation treatment: effects on adult zebrafish fecundity, behavior and vitellogenesis in a 21 day exposure study**

J. Pohl, Swedish University of Agricultural Sciences (SLU) / Department of Biomedical Sciences and Veterinary Public Health; S. Orr, G. Carlsson, Swedish University of Agricultural Sciences / Department of Biomedical Sciences and Veterinary Public Health; B. Björnlenius, KTH / Royal Institute of Technology / Industrial Biotechnology Division; J. Fick, Umea University / Department of Chemistry; J.D. Larsson, University of Gothenburg, Sweden / Department of Infectious Diseases; L. Norrgren, Swedish University of Agricultural Sciences / Department of Biomedical Sciences and Veterinary Public Health

Toxicity evaluation during secondary effluents treatment by UV/H₂O₂ using Eruca sativa and Artemia salina

A. Malacrida, Universidade de Campinas / Technology Engineering; R.F. Dantas, Universidade de Campinas / Technology Engineering; T. Almeida, Universidade de Campinas / Technology Engineering; A.A. Chávez-Vargas, Instituto Politécnico Nacional. Escuela Nacional de Ciencias Biológicas; M. Hernández Zamora, Escuela Nacional de Ciencias Biológicas-I.P.N / Laboratory of Experimental Hydrobiology; F. Martínez-Jerónimo, Escuela Nacional de Ciencias Biológicas-I.P.N / Laboratory of Experimental Hydrobiology

When advanced oxidation processes are applied there is the concern of not forming more toxic compounds as a result of the oxidation and transformation of organic compounds. Therefore, the presence of contaminants of industrial origin may affect disinfection and form more toxic by-products. Thus, a detailed study of by-products formation and toxicity assessment during the oxidation processes contributes to a more accurate prediction of health effects. We screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP with a full scale pilot ozonation unit investigating endocrine, neurobehavioral and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₂ L⁻¹). We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 day/night cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformations and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent fortified with organic and a nitrogen compound in feed altered the biological activity. A second study related to behavioral effects was recorded in the adult fish exposed to the ozonated effluent. No adverse effects on the fish progeny was noted. Whether these biological effects would have an adverse impact on the population level remains speculative. Ozonation is a capable method for removing pharmaceutical residues from sewage effluents. Yet its implementation should be carefully monitored in order to minimize undesirable side-effects.

**WE084**

**Hospital effluent induced oxidative stress on Xenopus laevis larvae**

L. Pérez-Alvarez, Universidad Autónoma del Estado de México / Environmental Toxicology; H. Islas-Flores, Universidad Autónoma del Estado de México / Toxicology Ambiental; L. Gómez-Oliván, Universidad Autónoma del Estado de México / Farmacia; M. Galar-Martínez, Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas; N. SanJuan-Reyes, Autonomous University of the State of Mexico / Chemistry

Hospitals are one of the main sources of emerging pollutants to wastewater treatment plants (WWTP) that usually are fairly equipped to treat this kind of compounds. Activities performed in hospitals require the use of several compounds, which are potentially toxic, they can reach municipal wastewater, affecting how they get into municipal wastewater treatment plants, in some cases the procedure carried out in this WWTP is not able to remove all the contaminants, when they are not properly disposed, exposure to them can generate harmful effects on aquatic organisms. Physicochemical and pharmaceutical (11 pharmaceuticals) characterization of the hospital effluent were made, results shown a high concentration of mercury, and pharmaceuticals on concentrations of μg/L. Also oxidative stress was evaluated on Xenopus laevis larvae exposed to this hospital effluent; twenty oocytes were selected for each exposed group (control, 0.1, 0.3, 0.5, 0.7, 0.9 and 1 μmol/L) in the middle blast stage, they were maintained at constant temperature 23 ± 2°C, for 96 hours until they reached the larval stage. They were...
weighted, homogenized and centrifuged for the determination of hidroperoxides, lipopolysaccharides, carbon protein content, and the antioxidant activity of superoxide dismutase and catalase, results shown statistically significant increments regarding control group in all the biomarkers evaluated, thus indicates that the hospital effluent tested in this work can generate oxidative stress on Xenopus laevis larvae, based on the results obtained, hospital effluents can generate oxidative stress in other species and due the lack of appropriate WWTP hospital effluents can represent a risk for aquatic organisms.

An assessment of (anti-)androgenic activity in sludge from a rhesus spillway basin of the WWTP Aachen Soers as well as in sediments from the catchment area of the recipient water, the river Wurm K. Schröder, RWTH Aachen University; A. Shuliaiechiv, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute of Environmental Research; S. Horz, RWTH Aachen University / Institute for Environmental Research; S. Schiwy, RWTH Aachen University / Department of Ecotoxicology Analysis; H. Hollett, RWTH Aachen University / Institute for Environmental Research Hormonally active micropollutants (MPs) are a well-known problem in aquatic environments. They can severely alter entire ecosystems by disrupting the endocrine system of its organisms. Adverse effects can extend to invertebrates and vertebrates including humans. As many MPs cannot be completely eliminated during conventional treatment in municipal wastewater treatment plants (WWTP), they enter the recipient waters. So far, most of the effects of estrogenic active compounds have been investigated. However, a crucial part of the occurring hormone-equivalents is formed by androgen receptor inhibiting or activating compounds. Thus, the scientific attention has increased to account for their importance. Due to their strong lipophilicity, the main part of these compounds accumulates in fats in the body. In order to become hormone-disrupting MPs is the implementation of an additional treatment step like ozonation. Within the DemOAC Project, the WWTP in the catchment area of the river Wurm in Aachen Germany will be equipped with a large-scale ozonation. It is unknown how the concentrations of (anti-)androgens in sediments will be altered by this new treatment step. Up to now, controversial results were published regarding the elimination of (anti-)androgens by ozonation in effluents. Furthermore, sediments were rarely studied. To fill this scientific gap, this study will evaluate the status quo of (anti-)androgenic potentials in sediments and samples from the WWTP before the implementation of the ozonation at the WWTP in 2018. Investigation of samples from a rain spillway basin was conducted to measure the potential endocrine impact of the WWTPs, as this was evidenced in Kaiserslautern and bicycles contaminated areas. The wastewater generated from the city’s informal settlements and the impact zone and the individuation of eventual bacteriological community shifts as a consequence. The information obtained from this study contributes to the development of a methodology for the determination of the impact zone spatial boundaries and a dedicated environmental risk assessment approach for APIs in the impact zone. Occurrence of pharmaceuticals, metabolites and transformation products from combined sewer overflows in London measured by high resolution targeted, suspect screening and untargeted chemical analysis J. Barron, Kings College London / Analytical and Environmental Science; K. Munro, Kings College London; T.H. Miller, Kings College London / Analytical and Environmental Sciences; D.A. Cowan, Kings College London / Drug Control Centre; C. Martins, Thermo Fisher Scientific; J. Pereira, University of Aveiro / Department of Biology Centre for Environmental and Marine Studies CESAM Combined sewer overflows (CSOs) are controlled releases of raw, untreated wastewater to a river during times of heavy rainfall to avoid back-flushing of buildings and streets. The impact of CSOs on a river catchment with respect to pharmaceutical residues is not well understood. In London, CSOs occur ~2 times per week, as its Victorian sewer network struggles to cope. Here is a temporal study of the River Thames is presented to identify CSO-related occurrence of pharmaceuticals, including metabolites and transformation products. Daily samples of river water, influent and effluent wastewater were analysed using a validated method involving solid phase extraction (SPE) and liquid chromatography and high resolution accurate mass spectrometry (LC-HRMS). The work was divided into four parts: (a) the identification of CSO markers based on their retention; (b) determination of 30 pharmaceutical/metabolite occurrences in influent and effluent wastewater; (c) screening for CSO markers in receiving river water over a six-week period; (c) screening to identify metabolites/transformation products; and (d) classification of samples using untargeted data analysis. By differentiating influent and effluent, a CSO marker was identified, including caffeine, bezafibrate, benzoylecogomin and furosemide which were present in influent at relatively high-consistent concentrations. Following this, targeted analysis of the River Thames samples revealed that CSO marker concentration increased mainly during wet periods where the tide was low. A further 14 compounds were also discovered to observe any ‘dilution effects’ related to CSO events. Herein we present the first-ever quantification of MP occurrence in UK rivers measured by high resolution mass spectrometry. Results from a study of the occurrence of known metabolites/transformation products is also presented for a selection of compounds via machine learning prediction of LC retention times and mining of HRMS data. Finally, untargeted analysis revealed that river samples could be differentiated based on climate and/or tide height using principal component analysis and volcano plots. The use of several different modes of data analysis, the use of combined urinary metabolite and weight, complex understanding of complete occurrence data potentially influenced by timed CSO events. [1] K Munro, TH Miller, CPB Martins, AM Edge, DA Cowan, LP Barron, J. Chromatogr. A, 1396 (2015) 34–44 Occurrence, fate and bioactivity of pesticides in wastewater V.V. Yargeau, McGill University / Chemical Engineering; P. Westlund, AstraZeneca Global Environment; A. Gachanja, Jomo Kenyatta University of Agriculture and Technology / Chemistry; S. Comber, Plymouth University / Environmental Science Unlike for contaminants of emerging concern (CECs), data available for the occurrence, fate and bioactivity of pesticides (herbicides, fungicides, and insecticides) in wastewater treatment plants (WWTPs) is limited. Our research showed that of the 18 compounds investigated only imidacloprid, was not detected at the three WWTPs included in the study, confirming that municipal wastewater discharges contribute to the presence of pesticides in the aquatic environment. Using a suite of bioassays (high-throughput bioluminescence assay using the target species Vibrio fischeri, yeast estrogenic screen (YES) and yeast androsterone screen (YAS)) the bioactivity of pesticides in wastewater effluents treated using secondary treatment or ozonation was investigated. It was found that 12 of the pesticides showed either antiestrogenic or antiandrogenic activity and 7 compounds showed pleiotropic effects. This study was first to confirm endocrine activities based on yeast-based assays of recent neononitrois. The use of extended time points for the Vibrio fischeri, beyond the traditional 30 minutes, highlighted the necessity for some compounds was underestimated using only the acute test. Using a structure-activity relationship approach similar to the one used in hazard assessments, the relationship between toxicity and key physicochemical properties of the pesticides was investigated and trends were identified. This work also provided new knowledge on the removal of some fungicides (climbazole, myclobutanil and tebuconazole) by ozonation and demonstrated the recalcitrant nature of pesticides during ozonation. This study is one of the first to investigate antiandrogenic activity during the ozonation of a mixture of pesticides and an increased importance was reported. These findings further demonstrate the importance of combining bioanalytical tools to analytical chemistry in the evaluation of wastewater quality.
WE090

Perfume of fluoroalkyl substances within a small stream food web affected by sewage effluent

D. Cerveny, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry; K. Grabicova, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters; J. Turek, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry; V. Zlabek, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters, LECHB; T. Randak, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry

Within our experiment, the fate of fourteen PFASs was studied in an ecosystem of a small stream affected by STP’s effluent. The unique field experiment design was carried out to allow long-term study focused on bioaccumulation of PFASs in indicator organisms and their ability of adaptation to the polluted environment. Two hundred brown trouts (Salmo trutta) originating from clean site within the same stream were tagged and stocked downstream the source of pollution. Those fish were recaptured after one, three, and six months they spent in the environment affected by the effluent of that local STP. Besides the fish stocked into the polluted locality from the clean site, also fish originally inhabiting the downstream locality and macroinvertebrates from both sites were sampled and analysed. Passive sampling approach using polar organic chemical integrative samplers (POCIS) was applied to determine occurrence of PFAS in water soluble fraction over the course of the experiment instead of conventional grab water samples. Twelve of the fourteen target PFASs were found in concentration above the LOQ in at least one of the three-time points from downstream locality while only three were present in samples from clean site. The compound pattern varied significantly between fish, species of macroinvertebrates, and POCIS indicating several exposure pathways leading to bioaccumulation of PFASs in fish body. Concerning the accumulation of PFASs in fish, the highest concentrations were found in the liver of individuals sampled after three months of exposure. These concentrations rapidly decreased after six months although there was no significant change in occurrence of PFASs in water during the experiment. Such finding can be linked to both increase of water temperature leading to higher enzymatic activity and adaptation of studied fish to the polluted environment. Based on our results we also suggest that the process of adaptation might be related to the gender of fish as we found significantly higher occurrence of PFASs in males than in females. Overall those results indicate the susceptibility and efficiency of different commercial TiO2 photocatalysts (Aeroxide P25 and Hombikat UV100) by separately and simultaneously treating five different PFASs in aqueous solution under artificial UV irradiation (UVA: 40 W/m2 for 60 min). The pesticides were chosen as representatives, being frequently used for viticulture in the Trinatunaro River Area, a region where wine growing is one major form of agriculture. To evaluate product dependent efficiencies of TiO2 based photocatalysis, treated and untreated PFASs were analyzed for remaining PFAS concentrations and major metabolites before and after a combined TiO2 × UV treatment. Therefore, UV-visible absorbance spectroscopy, Total Organic Carbon (TOC) measurement and liquid chromatography was used. Further, to assess for the photocatalytic treatment efficiency, four daphnids were exposed to these treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO2 for reducing PPP concentrations and associated toxicity in water, making it an effective tool to counteract this difficulty. A digested slurry of PPPs is transported in water media, being rapidly pumped from an effluent point to an appropriate receiving point to reduce PPP concentrations and animal fat, another major environmental toxicant. Structures of the PPPs were submitted to the Czech National Information System for Plant Protection (NAdDW) program. We recommend evaluating the current pollution levels and their effects on the critical receiving point. We suggest the use of TiO2 based photocatalysis to reduce PPPs concentrations and reduce the environmental impact of PPPs in the receiving point. For protecting their crops many wine growers apply plant protection products (PPPs), which may accidentally end up in the aquatic environment e.g. after being washed off from agricultural machinery (AM). Once there, PPPs can negatively impact aquatic life which has been irradiated by UV light. This is a problem related difference in the degradation potential of TiO2 for the selected PPPs was observed. However, for a final statement whether TiO2 can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

WE091

Patterns of natural and human-made interacting processes on source, transport and fate of trace metals in the Adriatic Sea basin

M. Rocha, University of Bologna; T. Combi, Istituto Oceanografico da Universidade de Sao Paulo / Instituto Oceanográfico; L. Langone, National Research Council / Institute of Marine Sciences National Research Council ISMAR-CNR; R. Guerra, University of Bologna / Environmental Sciences; S. Miserezchi, National Research Council of Italy CNR / Institute of Marine Sciences National Research Council ISMAR-CNR; P. Giordano, ISMAR CNR

The Adriatic Sea has been under intensive influences of human activities, as well as natural processes. An intensive industrialization, together with urban and agricultural pollution and coastal eutrophication has greatly affected the open sea is attributed to the cascading of the North Adriatic Dense Water (NAdDW) in deep sea areas of the southern Adriatic, which would be able to quickly transfer suspended sediments (and, therefore, particle-binding contaminants) during episodic events and supports the inference that this region may act as the final reservoir for contaminants within the Adriatic Sea.

WE092

Photocatalysis as a potential pre-treatment process to reduce organic pesticide entries

F. Esperet, Inst. for Environmental Sciences / Institute for Environmental Sciences; R. Rosenfeldt, University of Koblenz-Landau, Institute for Environmental Sciences / Institute for Environmental Sciences; P. Garcia Munoz, N. Keller, D. Robert, V. Keller-Spitzer, Université de Strasbourg / Institut de Chimie et Procédés pour l’Energie, l’Environnement, et la Santé (ICPEES), CNRS; B. Altmayer, M. Twertek, State Education and Research Center of Viticulture, Horticulture and Rural Development / Institute of Plant Protection; S. Liedermüller, Universitat Koblenz-Landau / Institute for Environmental Sciences; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences

For protecting their crops many wine growers apply plant protection products (PPPs), which may accidentally end up in the aquatic environment e.g. after being washed off from agricultural machinery (AM). Once there, PPPs can negatively impact aquatic life which has been irradiated by UV light. This is a problem related difference in the degradation potential of TiO2 for the selected PPPs was observed. However, for a final statement whether TiO2 can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

WE093

Study of the efficiency of removing organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland


To cope with the increasing environmental pollution, electrochemical systems have been used to generate energy through the degradation of industrial and domestic effluents using electroactive microorganisms, these systems coupled to build wetlands (BES/CW) acquire the capacity to treatment effluents of various kinds. Although several studies have been performed to evaluate the efficiency of these systems for chemical oxygen demand (COD) removal and energy generation. To this aim, it was implemented two plastic containers with a volume of 20 L and an operating volume of 0.96 L, packed with river gravel and planted with phragmites sp., carbon felt was used for the construction of anode and cathode, both with a surface of 0.72 cm². The distance between both electrodes was 6 cm without proton exchange membrane, both electrodes were connected by a resistance of 1000 Ohms. The feeding was performed by gravity applying four pulses of 1.5 L/h, using synthetic water whose composition was similar to date reported by Yadav et al., (2012). The effect of two types of contaminants was evaluated azo dye (AD) and alkylphenols (AP), the voltage measurements were made daily after 20 days of operation, the time necessary for the development of the biofilm (from 9:00 h in intervals of 2h). The
COD measurement was performed weekly on the influent and effluent of both systems. After 40 days in operation, the systems showed voltage average values of 673 and 580 mV, maximum current densities of 20.8 and 37.5 mA/m^2 and COD removal of 38.5 and 36.71% for effluents AZ and AP, respectively. A significant increase in the current density was observed in the measurements taken after 13.00 h, which shows an effect of temperature on the generation of voltage and therefore current flow in the system. The results obtained represent a sustainable option for the exploitation of energy from domestic wastes from secondary effluents, which would not only improve the quality of the water before being discharged to the receiving bodies but also take advantage of the high concentrations of nutrients contained in these wastes.

WE094 Adsorption of Crystal Violet from Quaternary Basic Dye Mixture onto A Sawdust-Based Adsorbent

A. A. Giwa, Cape Peninsula University of Technology / Department of Pure and Applied Chemistry; K. A. Abdulsalami, Adeleke University, Ede. Nigeria / I Department of Basic Sciences, Chemistry Unit; F. Wewers, Cape Peninsula University of Technology / Chemistry; L. A. Bello, Ladoke Akintola University of Technology / Department of Pure and Applied Chemistry

Wastewaters from textile and other dye-using industries usually contain more than one dye. In such an aqueous matrix therefore, the adsorptive characteristics of a dye species are likely to be affected by the presence of the other dye species in the medium. The removal of crystal violet from aqueous solution by sulphuric acid treated sawdust, a by-product in the process of making malachite green, methylene blue and rhodamine B on its adsorption from binary, ternary, and quaternary dye systems were studied. The combined effect of mixture components and process parameters on the adsorption was studied and optimized using response surface methodology. The adsorbent was characterized and the experimental data obtained were fitted to different kinetics and isotherm models. The experimental results were modeled using an analysis of variance (ANOVA) statistical concept. The optimum contact time, pH, adsorbent dose and temperature were found to be 275.10 min, 9.94, 0.99 g and 60 °C respectively for the maximum decolorisation of 68.39 mg/L CV (97.2%). A linear model was used for the decolorization process through this design. The experimental values obtained were in good agreement with the predicted values, and the model developed was highly significant, with correlation coefficient of 0.985. The adsorption in all the dye systems investigated followed Freundlich isotherm, and the maximum monolayer adsorption capacity was between 18.87 - 24.39 mg/g, depending on the composition of the adsorbate matrix. The adsorption kinetics was well described by the pseudo-second order model (R^2 > 0.95). All the eight adsorbate systems investigated were endothermic (ΔH positive; 35.30 to 43.66 KJ mol^-1), thermodynamically feasible (ΔG = 2.30 to -6.13 KJ mol^-1) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment

I. Hellea, SINTEF Ocean, Stavanger, Norway; A. Fuglestvedt, SINTEF Water; F. Lönn, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology

Discharges from wastewater treatment plants (WWTPs) are a source for pollutants to the environment. Here we studied influent patterns and removal of selected elements in two Norwegian wastewater treatment plants (WWTPs) LARA and HØRA in Trondheim, Norway. Both WWTPs have significant industrial contributions, especially from the chemical industry. Sampling was performed twice a week from 24 h composite samples of raw influent wastewater, as well as sludge samples, were taken to determine influent concentrations and removal of Al, P, S, Cr, Fe, Ni, Cu, Zn, As, Cd and Pb. To study release patterns and gain information about potential sources, diurnal variations of elemental concentrations were determined and modelled in 8 composite samples of raw influent wastewater from morning, evening and night discharges. Element concentrations were lowest in influent samples, the highest in treated sludge. There was an increase in the removal efficiency of 80% for Pb, Cd and Al and lowest for Cd < As < Cu and Pb. Concentrations of Al, P, Cu, Cr, Fe, Ni and S were significantly higher in the treated effluent compared to the raw influent, deriving from the use of inorganic flocculant. This was also reflected in Fe and S concentrations in treated sludge. Elemental concentrations in 8 composite samples mostly followed general diurnal discharge patterns, with higher concentrations in mornings and evenings and lower concentrations at night. In HØRA, concentrations of most elements further correlated well with total suspended solid concentrations (TSS), with the strongest correlations observed for P, S and Cu (R^2>0.9). Correlations with TSS were less pronounced in LARA, and were weakest for Pb, Fe and Cu (R^2<0.6), which can be potentially attributed to the higher industrial loading contributions in LARA.

WE096 Rapid detection of E. coli in wastewater effluent and impact of effluent discharge on riparian invertebrate diversity

P. M. Mosololane, University of the Free State / Zoology and Entomology

Effluent samples from wastewater treatment plants are expected, due to the treatment processes, to have lower concentrations of toxicants and pathogens than the influent. As such, they are expected to have a lesser impact on the environment than the influent. The aim of this study was to seasonally assess the efficiency of Phalaborwa’s wastewater treatment plant in removing pathogens (E. coli) from its effluent and to determine the impacts of that effluent on invertebrate diversity along the riparian zone of the receiving watershed. Loop mediated isothermal amplification technique was used to screen for the presence of E. coli in effluent samples. There was negative identification of E. coli in the samples collected. Impacts of effluent on invertebrates will be determined by analysing the changes in population dynamics of the invertebrates found in the riparian zone, above and below discharge point of the Wastewater Treatment Plant. At least, 13 morph species of eight insect families have been identified. Taxon diversity will be calculated using the Simpson-Yule Index, from where significant difference analysis would be calculated for environmental variable, species abundances and diversity data. More screening for the presence of E. coli will determine the efficacy of the wastewater treatment plant in removing pathogens from its effluent. Further identification and presence or absence of invertebrates in the sampled riparian zone will determine if E. coli has any impacts on invertebrate diversity.

WE097 The DemO3AC-project: Chemical and ecotoxicological investigations of the wastewater treatment plant Aachen

S. Schwie, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; Y. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shuliakevich, Institute for Environmental Research (RWTH - Aachen University) / Institute for Environmental Research; S. Köne, Institute for Environmental Research RWTH; S. Oster, RWTH Aachen University, Institute for Environmental Research; K. Klaar, R. Dolny, Institute of Environmental Engineering, RWTH Aachen; S. Classen, Research Institute gieh; M. Hammers-Wirtz, gaias Research Institute for Ecosystem Analysis and Assessment Aachen; I. Brückner, Eifel-Rur Waterboard; J. Finnekempe, RWTH Aachen University / Institute for Environmental Research; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Microplutants (MPs) in municipal wastewater, like pharmaceuticals, are not sufficiently removed by conventional cleaning methods in wastewater treatment plants (WWTPs). As a consequence, complex mixtures of MPs discharged into the receiving streams and may cause various effects on the aquatic biota. To decrease the release of MPs into the environment, a full-scale ozone treatment is implemented into the WWTP Aachen Soers, Germany within the DemO3AC-project. A crucial part of this project is the evaluation of the ecological and chemical state of the receiving stream, the River Wurm. This study focuses on the status quo of this river. To assess the impact of MPs, water samples were taken at 3 treatment steps within the WWTP and at 4 sampling sites (upstream and downstream the WWTP) along the river Wurm, Germany. From these samples were collected and processed. To include various adverse effects a broad test battery was conducted (acute, chronic, mechanism-specific, in vivo and in situ) along with chemical analysis. The analysis of 60 MPs showed mainly the presence of pharmaceuticals and plasticisers/phthalates. In total 52 substances could be detected. A general elimination rate of about 55% was determined. The toxic potential was high in the WWTP inlet for D. magna, D. subspicatus and D. rerio. A. fisheri showed no effect. However, the toxicity was already markedly reduced at the outlet of the WWTP. No acute and chronic toxicity was detected in any of the Wurm samples. Similar results were obtained in in situ feeding experiments with G. pul財x. No significant differences in feeding rate between the sampled sites were recorded. On the other hand, significant mutagenic and endocrine effects were observed at the inlet and outlet of the WWTP as well as at all sampling sites within the Wurm. The P. antipodarum reproduction assay showed also a significant increase in embryo production downstream of the WWTP. In parallel, experiments with river sediments and samples of an additional WWTP (upstream of the WWTP Soers) will be conducted to clarify to which amount the mutagenic and endocrine effects originates by different sources as the WWTP Aachen Soers. The second part of this project will contain comparative studies investigating the situation after the implementation of the full-scale ozonation. This project is funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North-Rhine Westphalia.

WE098 To use or not to use: sewage overflow dredging

M. Hagelmann, Bioclear earth

In a densely populated country like the Netherlands, with a dense sewage system,
many sewage overflows into surface water are present. Sediment located 250 m before and after the overflow needs to be discarded and burnt after dredging while ‘normal’ sediment can be reused as soil. Discard and burning is expensive for water boards, besides the fact that it costs a lot of energy and causes air pollution due to transportation, which is not sustainable. Also it causes a loss of raw materials. The water board Noordzeijp has started a pilot for reusing sewage overflow dredgings as soil for reclamation purposes for agriculture. For this purpose two depots have been set up: one with reference sediment and one with overflow sediment. During one year the concentrations of pharmaceuticals and pathogens will be monitored as well as antibiotic resistance and endocrine disruption. The basis of the project is the hypothesis that pathogens will be killed during the process of drying and pharmaceuticals will be (biologically) degraded with many of them lost due to volatilization. The end result is a reduction of pollution and a way to make use of the otherwise contaminated sediments.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health (P)

Several species with different trophic levels growing together, where each species has its own economical value. Macroalgae can be used in such systems, usually at several regions, we can ultimately ingest high levels of these contaminants, which are not legislated the same way as other fish products. Exposure tests were performed with the macroalgae Ulva lactuca in order to evaluate the effects of Enrofloxacin in growth. Antibiotic concentrations were measured in seawater and macroalgae discs at several sampling points, after immersion in an Enrofloxacin bath at two different concentrations. These results can help comprehend how IMTA managed pollution in order to prevent contamination with antibiotics. As biofilters, these organisms are located at the exit point of fishponds or near cages, potentially accumulating pharmaceuticals.

WE101 Antibiotic resistance genes in manure, stored manure and soil after manure application

M. Virta, K. Pärnänen, University of Helsinki; R.D. Stedtfeld, J.M. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; J. Muurinen, University of Helsinki / Food and Environmental Sciences

Production animal farms are proposed to act as reservoirs where genetic material from contaminated feed and contaminated manure can be spread. After fertilization of the soil, manure will be mixed with other soil material, which makes resuse of the dredgings possible. In June 2017 the sediments were sampled and analysed. In October dredging was performed and the pilots have been set up. The first monitoring round was performed one week after set up. In each monitoring round chemical analyses are performed on pharmaceuticals. Pathogens are identified by both culturing methods and Next Generation Sequencing (NGS), combined with viable PCR analyses to quantify specific pathogens that have been identified by NGS. Antibiotic resistance will be monitored by means of ERICA (extended Spectrum Beta-Lactamase) measurements. Endocrine disruption will be monitored by means of ER-Calux tests. In the presentation the background of the project will be sketched, then the results of the monitoring up till May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for resuse possibilities will be given as well as the meaning of the project for other water boards.

WE099 Assessing wastewater processes at oil refinery industry in Kazakhstan

I. Radelyuk, Lund University / Department of Building and Environmental Technology; K. Tussupova, LTH, Lund University / Department of Building and Environmental Technology

This paper presents the first attempt to assess the wastewater treatment processes at the oil refinery sector in Kazakhstan and evaluate to what extent these processes follow international and national regulations regarding industrial waste water treatment. The assessment was performed considering wastewater discharge from refinery processes at three factories in the country. While Kazakhstan’s environmental regulation promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. The national regulation allows discharge of wastewater to natural or artificial ponds by not exceeding the concentration in human and animals. Therefore it is reasonable to expect that ARGs and MGEs were present in soil, hence a consequence of fertilization. How the abundance and number of these ARGs and MGEs clearly decreased from fertilized soil to 2 and the 6 week sampling points. Only 29 samples were positive in unfertilized soil samples. Manure had the highest relative abundances of ARGs, and these manure-associated ARGs were not detected in unfertilized soil or ditch water sampled before fertilization. Likewise, ARGs abundant in unfertilized soil or in ditch water were not abundant or even detected in fertilized manure. After fertilization the manure-associated ARGs and MGEs were present in soil, which makes resuse of the dredgings possible. In June 2017 the sediments were sampled and analysed. In October dredging was performed and the pilots have been set up. The first monitoring round was performed one week after set up. In each monitoring round chemical analyses are performed on pharmaceuticals. Pathogens are identified by both culturing methods and Next Generation Sequencing (NGS), combined with viable PCR analyses to quantify specific pathogens that have been identified by NGS. Antibiotic resistance will be monitored by means of ERICA (extended Spectrum Beta-Lactamase) measurements. Endocrine disruption will be monitored by means of ER-Calux tests. In the presentation the background of the project will be sketched, then the results of the monitoring up till May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for resuse possibilities will be given as well as the meaning of the project for other water boards.
producing among others oxidative stress, cyto, neuro and hepatotoxicity were induced after treatment with CIP in mice and rats. However, ecotoxicological effects on aquatic organisms of CIP and FL are practically unknown. In our study specimens of the clam Scrobicularia plana were exposed to control water and a mixture of IBU, CIP and FL at close environmentally relevant concentrations (10 y 100 µg/L each) during 21 days with the aim of studying toxicological responses also in longer time frames. All organisms along the post-exposure depuration. Bioaccumulation of pharmaceuticals in clams was examined and changes in a suite of molecular biomarkers was used to evaluate the biochemical status of clams during both exposure and depuration: biochemical responses related to oxidative stress (CAT, SOD, GR, T-GPx activities and LPO levels), detoxification (GST activity) and neurotoxicity (AChE activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam S. plana.

**WE103**

Changes in the environmental risk of veterinary antibiotics after the introduction of antibiotics-reducing policies

E. Han, D. Lee, Seoul National University / Environmental Planning Institute

Graduate School of Environmental Studies

In recent decades, pharmaceuticals in the environment have been concerns for environmental. Especially, the residual antibiotics in the environment could lead to adverse effects on non-target organisms, contamination of food and drinking water supplies, and increased antimicrobial resistance (AMR). Since 2000s, in Korea, the policies for reducing antibiotics usage, such as Separation of Dispensing and Prescribing of Drug, or Restriction of Adding Antibiotics in Animal Feed, have been enforced in view of public health management. Throughout the period of usage, the model covers pharmaceutical life cycle posterior to consumption, including direct discharge, manure composting, and land application over the agricultural soil. The emission model was combined with SimpleBox and SimpleTreat into a single spreadsheet-type model for calculating the PECs. In the present study, antibiotics which are of top 20s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norflloxacin, etc) has decreased, however, the uses of non-regulated antibiotics (Florfenicol, Tilmicosin, etc) have steeply increased (255 times for Florfenicol, 13 times for Tilmicosin), implying emerging risk. The method used in the present work may serve as a quantitative tool to efficiently assess the policy about pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Han; Dong Soo Lee, Application of emission estimation model to the environmental risk assessment of the pharmaceuticals.

**WE104**

Development of microplate based assay and its application to establish differences in cyanobacteria sensitivity to antibiotics

G. C. Le Pagg, University of Exeter / College of Life and Environmental Sci; M. Trznadel, L. Gunnarsson, University of Exeter / Biosciences; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

Antibiotics are continuously entering the environment and pose a risk to environmental health through their direct effects upon microorganism communities and to human health through antimicrobial resistance. They are designed/selected to target bacteria but in current environmental risk assessment (ERA) only one species of cyanobacteria and the activated sludge respiration inhibition test (ASTRIT) are considered to be sensitive to antibiotics. This is therefore concern that the potential impacts of antibiotics on environmental health are not fully considered in ERA. We have developed a microtiter assay that broadly follows and meets the validity criteria of the OECD 201 test guideline as a cost-effective way to determine the effect of antibiotics on cyanobacteria growth. We applied this assay to determine growth-rate effects on 8 species of cyanobacteria to establish differences in species sensitivity for the improvement of ERA of antibiotics. Our key findings are: 1) the performance of the microtiter assay is suitable for accurate and reliable assessment of effects on growth inhibition in a wide range of bacterial species; 2) differences in cyanobacteria sensitivity to antibiotics can span several orders of magnitude; and 3) the current framework for ERA of antibiotics inadequately addresses the risk to bacterial populations and testing several diverse cyanobacteria species will increase confidence in the protection goals established. Direct and indirect effects of antibiotics in the leaf-shredding macroinvertebrate Gammarus fossarum

M. Konschuh, University Koblenz-Landau / Institute for Environmental Sciences; J.P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; C. G. C. Le Page, University of Koblenz-Landau / Institute for Environmental Science; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bundschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment

Recent studies indicated that both leaf-decomposing microorganisms (i.e., bacteria and fungi) and macroinvertebrate detritivores (i.e., shredders) can be affected by antibiotics via direct and indirect pathways (i.e., bioaccumulation, microorganism-mediated food quality). However, relatively little is known about these effects on shredders. Therefore, we performed a comprehensive study involving three experiments, which aimed at unravelling the importance of waterborne and diet-related effects of the antibiotic ciprofloxacin (CIP) on the model shredder Gammarus fossarum. During a 7-day feeding activity assay, we assessed the effects of waterborne CIP exposure on gammarids’ survival and feeding activity, while alterations in leaf palatability for G. fossarum due to microbial colonization of the leaves in the presence of the antibiotic were investigated using food choice assays (i.e., diet-related pathway). Furthermore, during a long term assay of 24 days, sublethal effects (the shredders’ energy processing and physiological fitness) were assessed when either subjected to a mixture of IBU, CIP and FL at close environmentally relevant concentrations (10 y 50 µg/L each) during 21 days with the aim of studying toxicological responses also in longer time frames. All organisms along the post-exposure depuration. Bioaccumulation of pharmaceuticals in clams was examined and changes in a suite of molecular biomarkers was used to evaluate the biochemical status of clams during both exposure and depuration: biochemical responses related to oxidative stress (CAT, SOD, GR, T-GPx activities and LPO levels), detoxification (GST activity) and neurotoxicity (AChE activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam S. plana.

**WE106**

Efficacy of removal antimicrobial resistance genes during avian manure composting process

F. Esporón, M. Delgado, M. Carballo, INIA - National Institute for Agricultural and Food Research and Technology; M. Ugarte-Ruiz, M. Moreno, UCM; J. Tadeo, INIA - National Institute for Agricultural and Food Research and Technology; A. de la Torre, INIA - National Institute for Agricultural and Food Research and Technology / Environmental Health

Antimicrobial resistance (AR) is an emerging and global problem. Therefore, there is currently a remarkable effort to understand the mechanisms of resistance, to promote the responsible use of antimicrobials and to seek effective therapeutic alternatives. While most livestock studies are focused along the food chain, there are few available studies about the role of livestock manure in the spread of AR. The direct application of animal waste (or slurry) to crops may favor the transmission of AR from cattle to vegetables. The objective of this work is to evaluate the impact of the composting process on the persistence of AR genes. For this, a composting of 10 weeks of duration has been carried out from straw and avian manure, from a laying hen production. Composting samples were taken in triplicate at the end of each week, and total DNA was extracted from each. 22 genes coding for resistance to tetracyclines, sulfonamides, phenicols, aminoglycosides, quinolones, beta lactams, vancomycin and colistin were determined and quantified by real-time PCR. 16 of the 22 genes were detected in at least one sample. Analysis of the temporal evolution of the resistances shows that there is a marked reduction (> 97%) in the genes coding for tetracycline, b-lactam, quinolone and macrolide resistances, while an increase in aminoglycoside and sulfonamide resistance genes is observed. These genes usually form part of integrons, which have more persistence into the environment. Besides, we have found positive correlations among almost all ribosomal protection genes and with the deactivation genes; whereas efflux pump genes were positively correlated among them, suggesting that the persistence of antimicrobial resistance genes could be related to their mechanisms of action. In conclusion, although the composting process does not end up eliminating the AR genes, it can be considered a alternative to the environmental management of the avian manure. RTA2014-00012- C03-02 and S2013/BMI-2747.

**WE107**

Environmental Assessment Of Multi-Class Pharmaceutical Residues In The Tejo Estuary

S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences
are produced in farms and this waste material is commonly applied to fields as a fertilizer in the UK. The health of a dairy herd is supported by the administration of antibiotics so the dairy farming setting works as an antimicrobial resistance (AMR) reservoir and as a route of entry into the environment. Antibiotics’ persistence in dairy settings occurs through mediums such as slurry, milk and subsequently, in soil via spreading. These routes can act as a channel for the transference of compounds and the innervation of AMR within the food chain through intake by plants and migration to other sources via water run-off, possibly affecting the therapeutic efficiency of antibiotics against human and animal health. Therefore, the increasing soil retention of polar substances after soil amendment and the high persistence found for some antibiotics in batch experiments (e.g. sulfonamides), make further research on exposure assessment necessary along with the analysis of veterinary antibiotics in dairy environments in order to assist in shedding light on the long established concern of the environmental fate and behaviour of veterinary antibiotics in farming and to propose better handling practices as a basis for future regulations. The main objective of this study is to measure the distribution of select antibiotics currently in use within the farm environment, relating their presence to the length of use and the last date of prescription. For this purpose, specific optimized analytical methods including 19 antibiotics belonging to 10 different families were employed for clean-up and pre-concentration of different matrices (slurry, soil,milk) by means of liquid-liquid extraction, followed by solid-phase extraction (SPE) and identification and quantification by liquid chromatography-mass spectrometry (LCMS). For instance, several veterinary antibiotics under study were detected in wastewater slurry with concentrations up to 18.6 µg L⁻¹ for oxytetracycline suggesting a high persistence. 2. Summarizing, this is the first step towards the evaluation of the impact of antibiotics presence and fate in the AMR development.

WE110 How do freshwater and freshwater cyanobacteria react to long term exposure of antibiotics? Is there a potential increasing antibiotic resistance in the marine environment?
J.H. Heseding, C. Floeter, Hamburg University of Applied Sciences / Environmental Engineering
An increasing amount of pharmaceuticals are detected in waterbodies all over the world. Antibiotics are of special concern for the environment: Due to the high amount of medication, its specific activity against prokaryotes and a possible antibiotic resistance formation in the environment. Cyanobacteria have prokaryotic antibiotic target structures of antibiotics and are of high importance for the primary production and nitrogen cycle in marine waters. To investigate the long term effects of antibiotic exposure on limnic and marine cyanobacteria, the limnic cyanobacterial test according to OECD 201 and the marine cyanobacteria test developed by Heseding and Floeter in 2016 were performed several times. Exposed cultures were recultured at the end of the test and then reexposed to the same antibiotic active substance as part of a repeated test. As test organisms Synechococcus leopoliensis (limnic cyanobacteria) and Synechocystis spec. (marine cyanobacteria) were selected. The tests were carried out on a 24-well microwell plate. In the test, the percentage inhibition of the growth rate (cell number) is determined in comparison to the negative control over a period of 72 hours. The derived EC50-values after repeated exposition were compared for different antibiotics of environmental concern. The investigations are carried out as part of the PharmCycle project.

WE111 Impact of antibiotics on the feeding rate of the freshwater shrimp Gammopus pulex
G. Consolandi, University of Portsmouth; M. Bloor, University of Portsmouth / School of Earth and Environmental Science; A. Ford, University of Portsmouth / Biological Sciences
Antibiotics are one of the main categories of pharmaceuticals and their release into the environment can impact the natural bacterial and fungal communities, which can threaten the survival of organisms that rely on them as a food source. One such organism is the freshwater detritivore Gammopus pulex that commonly feeds on detritus such as, naturally conditioned Ailtna glutinosa leaves. The study aim was to establish if the feeding rate of Gammopus pulex was altered when their food source (Ailtna glutinosa) was exposed to environmentally realistic concentrations of antibiotics during the natural leaf conditioning process. The investigation included three antibiotic scenarios (1) exposure to the bacteriostatic agent Tetracycline, (2) exposure to a mixture of Sulfamethoxazole and Trimethoprim bacteriostatic agents that are commonly prescribed together and (3) exposure to the bactericidal agent broad-spectrum antibiotic Ciprofloxacin. 24 h feeding assays were performed using Ailtna glutinosa leaf discs of 1.3 cm Ø and standardised Gammopus pulex specimens (n=60). The organisms were kept at 15°C under a 12:12 h light:dark cycle. 15 replicates were undertaken with three environmental realistic concentrations and a charcoal filtered tap water control (200 mg/L, 20 mg/L and 2 mg/L). The leaf discs were photographed at the start and finish of the investigation and these images underwent analysis with Image J software in order to calculate the area consumed. After 24 h, the Gammopus pulex were sacrificed by exposure to -20°C temperature before being dried at 60°C for 24 h and weighed. This protocol was performed with antibiotic scenario 1, 2 and 3. The results showed that Tetracycline (Z=0.198, p=0.897) and Ciprofloxacin (Z=1.568, p=0.117)
Impact on the microbial communities of sites. Fluconazole levels ranged from 26S rRNA gene indicated that a high number of gene copies were present at all and occasional direct contact with polluted water could cause infections to immune associated with polluted waters. Some isolates in the present study are pathogenic krusei, C. tropicalis were analysed with liquid chromatography coupled to a quadrupole time analysis water samples were extracted using soli...
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selective pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spurring serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there is considerable resistance-associated fitness costs. However, intricate bacterial compensatory mechanisms, population dynamics and long-term persistency can lead to resistance gene emergence and enrichment (e.g. via horizontal gene transfer). Therefore, there is a need for a better understanding of how concentrations of antibiotic relate to the abundance of resistance genes in different environmental compartments under different conditions. In this study, we compiled this sparse information by conducting an extensive literature meta-analysis to evaluate global trends. Our investigation showed the environmental matrices and changes in gene abundance (e.g. surface water). Interestingly, there are cases where gene variation is weakly correlated with antibiotic concentration (e.g. sediment) which challenges the common proportionality assumption between these two parameters. This indicates that AMR genes can be highly maintained throughout bacterial communities under certain environmental conditions. Whether detected gene levels are antibiotic-induced or the consequence of other factors, such as microcosms enrichment (e.g. via urban effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.

**WE117**

**Sulfamethoxazole degradation in river water microcosms and effect on the natural microbial community**


The widespread use of antibiotics causes concern on their occurrence and fate in different environmental matrices. Following administration, antibiotics are partially metabolized and a large amount is excreted unaltered or as active metabolites, reaching wastewater treatment plants (WTPs). Most WTPs are not able to remove them efficiently and through their effluents, they reach surface water. The synthetic compound sulfamethoxazole (SMX) is one of the most prescribed and consumed sulphonamide antibiotics to treat urinary tract infections used both in human and veterinary practices. The widespread use of SMX implies its antibiotic-induced or the consequence of other factors, such as microcosms enrichment (e.g. via urban effluents) which challenges the common proportionality assumption between these two parameters. This indicates that AMR genes can be highly maintained throughout bacterial communities under certain environmental conditions. Whether detected gene levels are antibiotic-induced or the consequence of other factors, such as microcosms enrichment (e.g. via urban effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.

The study on *Lemna minor* was conducted according to the OECD Guidelines for the testing of chemicals 221. *Lemna minor* species were cultured in Swedish Standard (SIS) growth medium and effects of the antibiotics on growth assessed over 7 days. The results of the study showed EC50 values of each test compounds ranged from 2.8 to 21.8 mg/L. *Lemna minor* was most sensitive to the sulfamethoxazole, with its EC50 being below 10 mg/L. The test on algae was performed according to the OECD Guidelines for the testing of chemicals 201. *Chlorella vulgaris* were cultivated in Tamm's medium and algae numbers were counted in Goryaev chamber under a microscope. The macroalide substances azithromycin and clarithromycin were found to be the most toxic compounds to the algae with EC50 values being lower than 1 mg/L. In the future, it is recommended to perform assessments on the sensitivity of other less well studied aquatic species to priority AMR. In the future, it is also recommended to perform monitoring studies to establish levels of exposure in the country. This will then provide a basis for the risk of these substances to be established.

**WE119**

**The Presence of Human and Veterinary Antibiotics in Urban and Rural Streams of North Carolina**

A.D. Gray, University of North Carolina at Greensboro / Biology; D. Todd, University of North Carolina at Greensboro / Chemistry; A.E. Hershey, University of North Carolina at Greensboro / Department of Biology

Antibiotic pollution is of concern to environmental health sciences due to the implications associated with their presence in the environment. There is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in stream ecosystems in the United States remains a research area that has received little attention, while more research has focused on antibiotics in larger rivers, lakes and estuaries. Streams ecosystems play a crucial role in the transport of water from inland areas to coastal waters as well as to rivers and lakes, and have greatest potential to mitigate the risk from antibiotics related to direct discharges from animal farms or hospitals. However, there is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in stream ecosystems in the United States remains a research area that has received little attention, while more research has focused on antibiotics in larger rivers, lakes and estuaries. Streams ecosystems play a crucial role in the transport of water from inland areas to coastal waters as well as to rivers and lakes, and have greatest potential to mitigate the risk from antibiotics related to direct discharges from animal farms or hospitals. However, there is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria.

**WE120**

**The Role of Water Quality Analysis: Understanding our process environment to inform AMR**

J. P. Dodsworth, The University of Nottingham / Biosciences; R. Hellwell, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R. L. Gomes, The University of Nottingham / Faculty of Engineering Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Patrolecco, Water Research Institute

The presence of antibiotics in environmental water and that surrounding land use and infrastructure influences the presence of antibiotics in urban and rural areas. Work from the present study found human and veterinary antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulferamazine, trimethoprim, danofloxacin, sulphaquinoxaline, streptocin, enrofloxacin, and tylosin, with several of the detected antibiotics being present in both urban and rural streams. Results from this work demonstrate that streams are key sites regulating discharge of antibiotics to larger bodies of water and that surrounding land use and infrastructure influences the presence of antibiotics in streams and urban and rural areas.

**WE121**

**Safety and efficiency assessment of antibiotic administration by magnetic nanoparticles in Zebrasfish**

G. Chemello, C. Piccinetti, B. Randazzo, O. Carnevali, F. Maradonna, Università Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Radaelli, Università degli Studi di Padova; A. Fifi, Biotecnologie B.T. Srl / Ecotoxicological and chemical; F. Gigliotti, CRO BioTecnologie BT; I. Olivotto, Università Politecnica delle Marche
The indiscriminate use of antibiotics in the aquaculture sector has raised public concern because of possible toxic effects, development of bacterial resistance, and accumulation of residues in individual tissues. Even if several countries have developed regulations about their use, it is clear that long-term growth of the aquaculture industry requires both ecologically sound practices and sustainable resource management. Alternative strategies for better management of antibiotic administration are of primary interest to improve antibiotic efficacy rates and, as a consequence, to reduce their release into the aquatic environment. The present study investigates, for the first time to our knowledge, a new methodology for oxytetracycline (OTC) administration through the use of iron oxide nanoparticles (NPs) (made of magnetite γ-Fe₂O₃) in zebrafish (Danio rerio). Fish were divided into 4 experimental groups: control; group A exposed to 4µg/L OTC (through water); group B treated with 10µg/mL OTC (parenteral exposure) to 4µg/L OTC, and group C exposed to bare NPs. HPLC analysis, histological analysis and other methods were applied to perform different evaluations. No detoxification processes or anatomical alterations were observed in fish exposed to bare NPs. Exposure of fish to the SAMNs@OTC complex resulted in a 10 times higher OTC accumulation with respect to using water exposure. This new method for OTC administration seems more efficient with respect to the traditional way of exposure and shows the potentiality to reduce antibiotic utilization and possible environmental impacts.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (P)

WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES.
L. R. Diniz, Universidade Estadual do Maranhão / Agroecologia; L. Capellini, Universidade Federal de São Paulo / UNIFESP / Departamento de Química Fullerenes are allotropes of carbon produced in highly energetic processes of organic origin or anthropogenic sources. In the last years, the increasing application of nanomaterials in several areas of human endeavor besides their physical and chemical properties, contribute for the growth of the global economy. However, the growing production and application of nanomaterials is also promoting discussions about the possible risks of these compounds to the environment and human health. Data have already been reported on the occurrence of fullerenes in different matrices, including the atmosphere, soils and sediments, and fresh water. Despite this, little information has been related to marine environments while coastal areas and estuaries are suspected to be one of their major sinks. The purpose of this study is developed and optimize an analytical method to evaluate the presence of nanofullerene (C60) in seawater samples. It will be tested two methods of extraction: dispersive liquid-liquid micro extraction (DLLME), and (2) QuEChERS, after, all the samples will be analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS). Keywords: Marine pollution. Fullerenes. Nanomaterials.

WE126 Screening of per- and polyfluoroalkyl substances (PFASs) and total organic fluorine in wastewater effluent from Nordic countries.
F. Chen, MTM Research Centre, Orebro University / SCHOOL OF SCIENCE AND TECHNOLOGY; U. Eriksson, R. Aro, MTM Research Centre Orebro University; L. W. Yeung, University of Orebro / Department of Chemistry; T. Wang, MTM Research Center; R. Kallenborn, Norwegian University of Life Sciences / Chemistry, Biology and Food Sciences; A. Karrman, Orebro University / MTM Research Centre.
The discharge of per- and polyfluoroalkyl substances (PFASs) into the environment via wastewater is a pressing public health issue. Apart from the frequently detected PFASs, such as PFOS and PFOA, more and more novel PFASs have been reported recently. We used the target screening method to identify novel and legacy PFASs in the Nordic environment. The aim of this project is to determine as many PFASs and total organic fluorine as possible in wastewater effluents from the Nordic countries and self-governing areas, including Finland, Sweden, Norway, Denmark, Faroe Islands, Iceland and Greenland. Field collected effluent (250 mL) were extracted by solid phase extraction (SPE). Identification and quantification of target compounds was performed using liquid chromatography–tandem mass spectrometry (LC-ESI-MS/MS). The significance of the occurrence, levels and patterns of various PFASs in Nordic wastewater effluents are discussed.

WE127 Quantitative evaluation of lag effect in polar organic chemical integrative sampler (POCIS) and modified POCIS with polytetrafluoroethylene (PTFE) membranes.
Y. Jeong, H. Kwon, KIST Europe / Environmental Safety Group; H. Jeon, KIST Europe; A. Mayer, E. Finnfrokken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics
Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring technique. Traditional grab sampling followed by laboratory extraction and instrumental analysis is well established method, but only provides a snapshot of the water quality status. Achieving representative sample with grab sampling takes considerable labour, time and cost. Here, time-integrative passive sampling technique is recognized as a promising monitoring tool. Passive sampling technique allows the simple sampler construction and application, provision of time weighted average concentration and in situ sampling. Various configuration of passive sampling devices are currently available, one of which is the organic chemical integrative sampler (POCIS). POCIS consists of Oasis HLB solid phase extraction column (SPE) + polytetrafluoroethylene (PTFE) membranes and has been widely used for the detection of hydrophilic contaminants in the past decade. However, uncertainties in quantitation of POCIS measurements have been pointed out as a main limitation of POCIS. Compound specific sampling rate depends on sampler configuration and environmental parameters such as flow rate and temperature. Lag effect from membrane sorption within POCIS further complicates the transfer kinetics of analyte. In this study, modified POCIS (POCIS-PTFE) with polytetrafluoroethylene (PTFE) membrane instead of PES membrane was tested in an attempt to avoid or lower the PES membrane sorption. The primary aim of this study is to (1) introduce modified POCIS and (2) identify the membrane sorption within POCIS in order to better understand partitioning kinetics of POCIS. In the laboratory experiment, the analyte mass fraction in membrane relative to total POCIS (i.e., Oasis HLB plus membranes) and membrane-water partition coefficient were determined for a range of compounds (log KOW from -0.03 to 6.26). Less membrane sorption was found in the...
Eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of four non-antibiotic pharmaceuticals (N-APs), four sulphonamides (SA), four tetracyclines (TCs), four macrolides (MCs), and one quinolone (QN) were detected in water, pore water, and sediment samples from Baiyangdian Lake, China. A total of 31 water samples and 29 sediment samples were collected in March, 2017. Caffeine was detected with 100% frequency in surface water, pore water, and sediment samples. Carbamazepine was detected with 100% frequency in surface water and sediment samples. Five N-APs were prominent, with mean concentrations of 4.90–266.24 ng/l in surface water and 5.07–14.73 pg/kg in sediment samples. Four MCs were prominent, with mean concentrations of 0.97–29.92 ng/l in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APs (53.26%) > MCs (25.39%) > SAs (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APs (42.70%) > MCs (25.43%) > TCs (14.69%) > SAs (13.90%) > QNs (3.24%) in sediment samples, and MCs (42.12%) > N-APs (34.80%) > SAs (11.71%) > TCs (7.48%) > QNs (3.86%) in pore water samples. The geographical differences of PPCP concentrations were largely due to anthropogenic activities. Sewage discharged from Baoding City and human activities around Baiyangdian Lake were the main sources of PPCPs in the lake. An environmental risk assessment for the upper quartile concentration was undertaken using calculated risk quotients, and indicated a low or medium high risk from 18 PPCPs in Baiyangdian Lake and its five upstream rivers.

Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan lake region, South Korea

J. Lee, Y. Lee, J. Lee, Seoul National University; S. Kim, Eulji University; M. Kim, Seoul National University / Department of Health Science; Y. Kho, Eulji University; K. Zoh, Seoul National University / Department of Environmental Health

Perfluorinated compounds (PFCs) are known to be endocrine disrupting chemicals and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n=2), fresh water (n=24), sediment (n=24), soil (n=24) and freshwater fish (n=27) samples were collected in Asan lake region, and the levels of PFCs in samples were analyzed. The concentrations of PFCs in ambient air were low, the lowest levels were found with freshwater between Pyeongtaek and Asan cities in Gyeonggi Province, and provides water for nearby industrial complex and agricultural areas. Two large streams join the lake and there are many industrial complexes near the streams. To analyze 16 PFCs, 2 samples were taken at each stream and 8 samples were taken at main lake. Analyses were carried out using LC/MS/MS after solid-phase extraction. The results showed that concentrations of ∑PFCs were ND~19.6 pg m⁻³ (for ∑PFCs) in air, ND~447.89 pg L⁻¹ (for ∑PFCs) in water, ND~9.7 ng g⁻¹ dry weight (dw) (for ∑PFCs) in sediments, ND~7.7 ng g⁻¹ dw (for ∑PFCs) in soil, and ND~35.0 ng g⁻¹ dw (for ∑PFCs) in the fish, respectively. The predominant species among the PFCs were perfluorooctanoic acid (PFOA) in air, perfluorooctanoic acid (PFOA) in water, perfluorotoluene sulfonic acid (PFOS) in sediment, soil, and fish, respectively. PFOS and PFOA were detected in all water, sediment, and fish samples. In air, 85% of total PFCs mainly existed as the gas phase compared to particulate phase. In water and sediment, higher levels of some PFCs were observed at the confluence of two streams, implying that anthropogenic activities from industrial complex in the upstream are the main source of contamination. Our study first reported the data of 16 PFCs levels in multimedia environment including air, water, soil, sediment, and fishes in Korea.

Seasonal changes in water and sediments’ microplastics in a Mexican estuary (Tecolutla).

L. Fischer Hernández, P. Ramírez Romo, U.A.M. Iztapalapa / Hidrobiología Microploastics (MP) are persistent contaminants that measure less than 5 mm, they have additives that are vectors of other POPs and metals, which can cause deleterious effects to the organisms that ingest them. MP can increase the temperature and decrease the sediments permeability. On the other hand, plastic particles are efficiently transported through water. There are just a few MP studies in Mexican aquatic ecosystems, so the objective of the present work was to evaluate the seasonal changes in numbers, size, color and form of the MP present in water and sediment of Tecolutla’s estuary. Water and sediment samples were collected in five different sites in three different climate seasons (northern storms, dry and rainy). In the laboratory water volume was measured and filtered through a cylindrical filter (Whatman #40) which was later dried at 50 °C for 24 h. Sediment samples were dried at 50 °C, a 40 g subsample was taken and hydrogen peroxide (30 %) was added to disintegrate all organic matter, followed by a zinc chloride solution (p = 1.5 g/l) to float the MP particles. Later the solution was decanted through a cellulose filter and dried at 50 °C for 24 h. MP particles on the filters were observed through microscope (Dissecting followed by digital Celestron) and photographs of the particles were obtained with imageJ software. Verification of the polymer identity was done through Scanning electron microscopy. MP size in water range from 10 to 1,730 µm, and their presence was higher in the northern storms season, followed by dry and rainy seasons with the highest numbers in a small tributary. Sediments had more MP and higher numbers in the dry season, with size ranging from 30 to 2,500 µm with highest numbers in the boat dock. Black was the most abundant color in both matrices followed by blue and red. Most MP were fibers. In conclusion MP were present in water and sediments year round, bigger particles were found in sediments and smaller in water. This is the first evaluation of MP in a Mexican estuary so continuing this type of research is important to
understand the biological significance of their presence.

**WE133**

Simultaneous biodegradation of water treatment additives: Transformation and byproduct formation, impact of biocide shock dosing and salinity

T. Wagner, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / IBED-ELD; A. Langenhoff, H. Rijnsdijk, Wageningen University / Environmental Technology; P. de Voogt, University of Amsterdam / IBED

Securing the supply of fresh water to fulfill the demand of the rising world population is identified as one of the largest environmental challenges in the near future. The Water Nexus research program aims at developing integral solutions for problems with water scarcity in delta areas worldwide. A significant fraction of industrial fresh water uptake is used in cooling towers. Several treatment technologies such as reverse osmosis, electrodialysis and membrane distillation may facilitate the reuse of discharged brackish cooling tower water. However, cooling towers water contains different water treatment chemicals such as corrosion inhibitors, biocides and antisalts that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is the use of CW systems such as constructed wetlands (CWs). Biodegradation is one of the main contaminant removal mechanisms in CWs. However, the biodegradation potential of CWs for many of the water treatment chemicals is not well understood. In this study, the simultaneous biodegradation of different representative water treatment chemicals by bacteria from CWs was explored. The representative water treatment chemicals included: 1) benzotriazole (corrosion inhibitor), 2) DBNPA (biocide), 3) glutaraldehyde (biocide), PEG (surfactant) and HEDP (antisalts). The following questions are addressed: Does shock dosing with biocides affect the CW biodegradation potential for the target chemicals? What is the influence of different salinities on the biodegradation of the target chemicals? Which signature microbial transformation products are being produced by single target chemicals that can be used as indicators of the presence of the target transformation products? Do different processes show ecotoxicological effects? Does the simultaneous biodegradation of multiple water treatment chemicals result in the production of new possibly harmful crosslinked products?

**WE134**

Fate of organic micropollutants in a small river: hydrological and chemical processes

C. Glaser, Center for Applied Geosciences / Center of Applied Geosciences; M.E. Müller, Eberhard Karls Universität Tübingen; F. Faltermeier, Eberhard Karls Universität Tübingen / Center of Applied Geosciences; C. Zwienen, Environmental Analytical Chemistry, Center for Applied Geosciences, University of Tübingen / Geosciences; M. Schwientek, Eberhard Karls Universität Tübingen; C. Zäpfel, University of Tübingen / Center for Applied Geoscience

Knowledge on pollutant transformation from laboratory experiments often fails to describe observations in the field. Thus, the CRC-CAMPOS aims to describe the fate and metabolism of anthropogenic pollutants on the landscape scale in different compartments in the Ammer catchment. This study is part of the subproject ‘Rivers’ and will identify and quantify the dominant processes from hydrology and chemistry which influence the fate of organic micropollutants in river systems. Field investigations take place in the Schönbrunnen River close to Tübingen (Germany) in the southwest of Germany, which is mainly influenced by agriculture. Salt tracer tests are combined with measurements of conservative ions and chemical tagging experiments. The results are based on the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunnen River. Dilution, mixing and dispersion processes can be identified with tracer tests and determine the residence time available for pollutant transformation. The quantification of the mass transport of pollutants in the river is possible by analysing conservative ions. This helps to derive and characterize chemical processes like photodegradation, sorption to particles or biochemical processes in biofilms from target screening data, mainly on pesticides. With the collected information from different disciplines, we get a larger picture about the pollutant mass transport in the Schönbrunnen River and adjoining compartments.

**WE135**

Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria

O.M. Ogunbanwo, University of Leeds / Geography (Physical); P. Kay, University of Leeds / School of Geography; L. Brown, University of Leeds / School of Geography; J. Wilkinson, The University of York / Natural and Built Environments; A. de Santa Catarina / Biochemistry Department; S. Sinclair, The Food and Environment Research Agency / Centre for Chemical Safety and Stewardship; R. Shabi, Lagos State Environmental Protection Agency

Pharmaceutical pollution of surface waters is increasingly recognized as a global problem, but to date, there have been no detailed studies from most African countries. In this study, the occurrence of 37 pharmaceuticals belonging to 19 therapeutic classes was studied in surface water and effluent in Lagos State, Southwest Nigeria. Samples were collected year-round from 22 surface water sites, and 27 compounds were detected at least once, many at extremely high concentrations. Maximum concentrations for a range of compounds, including trimeprimum, sulfamethoxazole, cimetidine, atenolol, and paracetamol were in the order of 150 microg L$^{-1}$. The mean concentrations for sulfamethoxazole, trimepiprin, cimetidine, paracetamol, lidocaine, metformin, carbamazepine and atenolol were 55.90 microg L$^{-1}$, 38.69 microg L$^{-1}$, 31.62 microg L$^{-1}$, 24.99 microg L$^{-1}$, 22.55 microg L$^{-1}$, 20.98 microg L$^{-1}$, 15.35 microg L$^{-1}$, and 15.10 microg L$^{-1}$ respectively. Venlafaxine has the lowest mean of 4.23 ng L$^{-1}$, other than the 10 compounds which were not detected. We compared our published data from around the world, these values vary by several orders of magnitude higher than most studies of pharmaceutical occurrence but similar to some other peak concentrations measured in developing countries such as China and India. Seasonal variations were observed for certain pharmaceuticals, i.e., antibiotics, paracetamol, tramadol, metformin, lidocaine, and carbamazepine which may be related to the endogenous release into the environment. The different water quality and agricultural activities in the area of study may lead to a high concentration of pharmaceuticals in the surface water. The values observed in this study are comparable with results obtained from previous studies. Moreover, these observations suggest that pharmaceuticals may be having an adverse impact on the environment, especially in developing countries such as China and India. Thus, the results of this study highlight the need to enact policies to clean up sewage discharges to rivers urgently.

**WE136**

Assessment of emerging contaminants in the L’Albufera Natural Park (Valencia, Spain)

D. Sadutto, University of Valencia / Environmental and Food Research Group, CIDE (GV, UV, CSIC); M. Andrés Costa, Universitat de València / Environmental and Food Safety Research Group; R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive

Pond wetlands play a critical role in maintaining natural cycles and supporting a wide range of biodiversity. They regulate water quantity, groundwater recharge, and can contribute to regulating floods and the impacts of storms, and provide the fish and rice. The Albufera Natural Park is one of the most representative and valuable coastal wetlands in the Valencia Region and the Mediterranean basin. Covering an area of 125 hectares, which has had around 200,000 people inhabiting the area for more than 50 years, and 160,0000 inhabitants has introduced a number of emerging contaminants that thrives within this wetland. In this study, 42 drugs of abuse and 45 pharmaceuticals have been studied in influents and effluents of 10 Wastewater Treatment Plants (WWTP), 7 irrigation channels and the Lake of L’Albufera de Valencia (Valencia, Spain). The occurrence of contaminants was analyzed and correlated to sewage discharge or socio-economic activities. Pharmaceuticals are indispensable in human lives, although, their usage and discharge into the aquatic environment could lead to ecological problems and the development of drug-resistant strains. Africa governments need to enact policies to clean up sewage discharges to rivers urgently.

**WE137**

EFFECTS OF URBANIZATION PROCESS ON WATER QUALITY OF RIVERS ON THE SANTA CATARINA ISLAND, BRAZIL.

M. Barbosa Xavier, Universidade Federal de Santa Catarina / Biochemistry; C.H. Soares, Universidade Federal de Santa Catarina / Biochemistry Department

The metropolitan region of Florianopolis has undergone an intense urbanization process in recent years, which has impacted the quality of life in this region. The objective of the present study was to evaluate the water quality of the Iaçuru river in its estuarine region, in order to evaluate the anionic changes occurring in the surroundings. Three sites were chosen, in which sediments and water samples were collected. The sediments were analyzed for the presence of sterols and pharmaceuticals by GC / TOF-MS after extraction with methyl tert-butyl ether. The water samples were analyzed with respect to the parameters: ammonia concentration, total phosphate, total phosphates, fecal coliforms and sulfide, according to the methodologies described in Standard Methods (APHA). TOF-MS chromatographic analyses of sediments and water samples were also performed on extracts obtained using SPE (Strata-X/dichloromethane). The results obtained showed high concentrations of ammonia, nitrogen, total phosphate, besides highly elevated coliforms. Between the analyzed steroids, cholesterol and derivatives such as coprostanol were identified at varying concentrations in the sediments of the several sites. Estradiol derivatives and drugs such as anxiolytics and remedies for sleep control were prominent in GC / TOF/MS chromatographic analyzes. The results confirmed the high contamination of the waters of the Iaçuru River by the discharge of domestic sewage. Ecotoxicological tests using fish are being conducted, including assay to assess genotoxicity.

**WE138**

Presence of emerging contaminants in sewage sludge and assessment of their environmental risk for the Albufera National Park, Valencia, Spain

M. Andrés Costa, Universitat de València / Environmental and Food Safety Research Group; A. Cuhat, Universitat de València / Environmental and Food Safety Research Group, CIDE (UV, GV, CSIC); R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the depuration process in the wastewater treatment plants (WWTPs). The study of emerging pollutants present in this sludge are far limited comparing with the water, mainly because of the challenge that involve their high content in organic matter making difficult their handling, storage and analysis. In Spain, the 80% of this sludge is employed in the agricultural sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples are from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 14,000 hectares devoted to rice crops. Samples were extracted by liquid phase extraction (LPE) with mixture of EDTA-McIlvaine buffer (pH 4.1) and methanol, assisted by ultrasound. Then, supernatant was cleaned up by the solid phase extraction (SPE) with Stratacron cartridges and analytes were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-mass-spectrometry of time-of-flight mass-spectrum (LC-QqTOF-MS).

As a result 50 compounds were identified, being the pharmaceuticals the most relevant, present in all samples, including nucleotides (adenosine triphosphate), amino acids (phenylalanine) or steroids (17α-oestradiol). On the other hand, several compounds were tentative identified and are pending of confirmation. The results of this study demonstrate the interest of high resolution mass spectrometry to draw the profile of contaminants in solid complex matrices. Furthermore, the data obtained provides information about the potential risk of use the sewage sludge for agriculture. Continue researching is needed to assess the real environmental risk related to this sewage sludge, since this could be a risk for human health.

Acknowledgements
This work has been supported by the Spanish Ministry of Economy and Competitiveness and the ERDF (European Regional Development Fund) through the project CGL2015-64454-C2-1 “Análisis de riesgos y viabilidad económico-ambiental de la eliminación de contaminantes. Diseño una herramienta de apoyo a la toma de decisiones” (Eco2TOOLS-DSS).

WE139 CHLORINATED BENZENES IN FISHES FROM DONGTING LAKE
L. Li, Y. Zhang, Institute of Water Resources and Hydropower Research, F. Zhang, China Institute of Water Resources and Hydropower Research. IWHR
Chlorobenzenes (CBs) are of worldwide concern due to their persistence, toxicity, bioaccumulation, and long-range transport. Hexachlorobenzene (HCB) and pentachlorobenzene (PeCB) are listed as persistent organic pollutants (POPs) by the United Nations Environment Program (UNEP). CBs production in China accounts for more than 50% of the worldwide CBs production. Hexachlorobenzene (HCB), 2,3,7,8-TCDD and PCBs are among the first priority pollutants in China and have been sprayed as molluscicide in Dongting Lake from 1960s to 1990s, it was estimated that over 9.8x106 kg of Na-PCP had been devoted into the lake; CBs were also carried into the lake with using of Na-PCP. CBs production as an intermediate of pentachlorophenol (PCP) has been identified as one of the main sources of environmental contamination. Dongting Lake is the second largest fresh water lake of China, which is also an area with most widely distributed chlorinated organics and has the most severe schistosomiasis epidemic situation in China. Na-PCP has been sprayed as molluscicide in Dongting Lake from 1960s to 1990s, it was estimated that over 9.8x106 kg of Na-PCP had been devoted into the lake; CBs were also carried into the lake with using of Na-PCP. The aims of this study were to investigate the occurrence of potential risk to aquatic organisms. The purpose of this study was to assess the reproductive effect of medaka (Oryzias latipes) under long-term exposure to Taimiflu metabolites. This study clearly carrie out the 56 day acute phase and 14 day long-term toxicity, 14-d reproduction, and 21-day hatchability trial bioassays to observe the survival, growth, and egg production of the adult medaka, and hatchability of embryo, and larvae body length of F1 medaka under the Taimiflu metabolite exposure concentration (0, 0.3 and 0.9 µg/L). Results showed that the survival and growth rates of adult medaka were no significant difference between the control and exposure groups. However, the egg production and F1 hatching rate of 90 µg/L exposure group had a downward trend compared with control group, but there were no significant decrease. This study found that larvae body length of exposure groups were significantly shorter than that of control group. This study concluded that Taimiflu metabolite could have a significant impact on larva growth development.

WE143 Earthworms (Eisenia fetida) response to chronic exposure to triclosan
J. Zalasaukaitė, Vytautas Magnus University / Department of Environmental Sciences; D. Mitkelytė, Vytautas Magnus University
Triclosan (TCS) is a broad spectrum antimicrobial and antifungal agent extensively used in industrial, household and personal care products. TCS widespread use has resulted in its introduction into environment and it has already been detected in surface waters, sediments, soil, living organisms and humans as well. The aim of the present study was to determine the response of Eisenia fetida earthworms to chronic triclosan exposure. Earthworms E. fetida were exposed to 10−50 mg kg−1 of triclosan in soil for 56 days. The impact of survival, growth rate, reproduction and antioxidative system was evaluated. TCS severely reduced the growth rate of E. fetida and reproduction. Chronic exposure to TCS in the soil induced a significant increase in the activity of antioxidative enzymes and malondialdehyde concentration.

WE144 Predicting the fate of pharmaceuticals during wastewater treatment and crop irrigation with reclaimed wastewater
M. Gonzalez García, C. Fernández-López, UCAM; F. Polesel, Technical
Wastewater represents an alternative option for use in urban areas, industry and especially, agriculture. Pharmaceuticals may undergo incomplete elimination in wastewater treatment plants (WWTPs) and are found in reclaimed wastewater, possibly being taken up in crops following wastewater irrigation. Among commonly consumed crops, vegetables are predicted to bioaccumulate considerable amounts of pharmaceuticals. In this study, we investigated the fate of pharmaceuticals compounds in a wastewater treatment plant (WWTP) equipped for the elimination of carbon and nutrients. The primary treatment consists of a screen, an aerated beam extraction tank and a primary clarifier. The biologically treated wastewater from the conventional activated sludge is filtered through a layer of a continuously operating sand filter prior to being disinfected by ultraviolet radiation. Effluents are used for irrigation in agriculture. We used the simulation tool “Activity SimpleTreat - fate model for ionics in wastewater treatment plants” [1] to predict the fate of pharmaceuticals compounds in the municipal WWTP. Model parameters were adapted to the situation at site. Chemical data were estimated using ACD/Lab. Model predictions were verified with measurements from a monitoring campaign in the WWTP. Results showed a high measured removal efficiency of Diclofenac, Ibuprofen and Ketoprofen concentrations in the WWTP and the simulation tool confirmed the same conclusion. As to uptake in lettuce, empirical results were compared to simulation outcome. For plant uptake prediction, a new steady-state model with translocation and phloem flow was applied [2]. Addition of phloem transport was necessary because the investigated compounds include weak acids (pKa 4 to 5), sucrose, and part of soil and fruit. Absorption and ion trapping in the alkaline phloem fluid (pH 8). The preliminary results with the new steady-state model, showed the uptake capacity of pharmaceuticals in different tissues of lettuce. The assimilation and distribution of pharmaceuticals compounds in the edible part of the lettuce leaves and the subsequent passage to the harvested plant parts is investigated. [1] Franco A. 2011. Activity SimpleTreat - fate model for ionics in wastewater treatment plants. homepage.env.dtu.dk/stt/Homepage%20anf/Website.htm [2] Trapp S. 2017. New release dynamic (numeric) coupled soil-plant uptake model for monovalent ionics, homepage.env.dtu.dk/stt/2017Release_Plant_Model/index.htm

**WE145 Exposure Assessment of Residual Organochlorine Pesticides (OCPs) in Orchards Soils and Fruits in Korea**


Residual organochlorine pesticides (OCPs) are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with significant potential impacts on human health and the environment. OCPs were designated as persistent organic pollutants (POPs) by the international community at the Stockholm Convention on Persistent Organic Pollutant. This study was conducted to investigate the OCPs residue in orchard soil, orchard grapes, and pear fruits. Recovery and limit of detection (LOD) of OCPs in orchard soils and fruits were 74.4 ± 115.6 and 7.9-74.3%, 0.04-0.08 and 0.2-0.4 µg/kg, respectively. The precision was reliable since the RSD percentage (5-7.5% and 1.4-8% for OCPs) was below 20, which was the normal percent value. The residue of OCPs in orchard soils was analyzed by the developed method, and endosulfan sulfate, 2,4-DDT, 4,4-DDT, 4,4-DDD, and 4,4-DDE were detected at 1.3-4.44-9, 2.2-31.9, 4.863-1, 1.9-48.0, and 2.3-119.3 µg/kg respectively. But OCPs in grape, peach, pear, and apple were not detected in all samples. These results showed that the residue in orchard soils were lower level than the precision was reliable which was below 20. This study provides useful data for the future research and management of OCPs in Korean orchards against the Stockholm Convention on Persistent Organic Pollutant.

**WE146 PhytoCOTE project: Assessment of organic and inorganic contamination in vineyard soils**

M. Trapp, LPTC / EPOC UMR 5805; J. Guillard, University of Bordeaux / EPOC UMR 5805; M. Dévier, University of Bordeaux / EPOC / LPTC UMR 5805; N. Vianella, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department

Concerning organic pesticides, a high diversity of molecules at different levels of concentration were found depending on crops. The results of the analyses will allow to show if: (1) the copper contamination level plays a role on the molecule degradation and contamination level; (2) the soil physical and chemical parameters play a role on the molecule degradation and on the copper and molecule retention; (3) the past and current soil uses impact the contamination levels.

**WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland**

E. Stutt, WCA Environment Limited; I. Wilson, G. Merrington, UK

Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical that thorough consideration of this exposure pathway and any resulting regulatory decisions are risk-based and made using robust evidence and science. Previous assessments of risks posed by contaminants in materials applied to land generally have several weaknesses. In the analysis: A. Vianello, such as sewage sludge, have not been made for the material directly prior to application to land and the assessments often have to make use of data from a different geographical locations and regulatory jurisdictions with mismatches in chemicals management policy. This project is seeking to address these issues on behalf of the Scottish Environmental Protection Agency by undertaking representative sampling and analysis of priority organic contaminants in a range of different organic materials that are frequently spread on land in Scotland. As a large number of organic compounds (in excess of 200) have now been identified in materials that are applied to agricultural land the first phase of this project has been to undertake a risk screening exercise. The purpose of this has been to identify organic chemicals likely to persist and/or bioaccumulate and to prioritise substances that are considered to pose a risk to human health or the terrestrial environment under reasonable worst-case assumptions for spreading. Results will be presented from the analysis of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land.

**WE148 Microplastics in Agriculture Soil.**

K.B. Olesen, Aalborg University / Department of Civil Engineering; N. van Alst, Aalborg University / Department of Industrial Engineering; S. Holt, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department

Microplastic is an environmental pollutant of worldwide concern. However, neither microplastic concentrations nor their sources or sinks are completely known. Here, we used a high-resolution infrared (μFT-IR) spectroscopy and attenuated total reflectance (ATR) to confirm the presence and characterize microplastics. Studies show the tendency of microplastic accumulation in wastewater sludge. This sludge is used as fertilizer in agriculture farming. This study focuses on the occurrence of microplastics in the size range 5000-10 µm in soils that received wastewater sludge as fertilizer. It presents the methods of sample preparation and presents field data. In Sweden 3 fields were sampled. Microplastics concentrations were presented per a period of 35 years. The fields had either received 3 tons/year, 1 tons/year or no sludge fertilizer. 40 kg of soil were sampled from each field. The microplastic concentration is in general low; therefore the plastic needs to be extracted from other materials present. Due to the large size range of interest, two different IR techniques are applicable for microplastic identification. This requires two different plastic extraction methods. Therefore, two sample protocols were developed: < 500µm and > 500µm. More than 50% of soil was dried and sieved through a 500µm metal sieve. To remove the inorganic fraction a gravimetric separation was used. For a sample of size 3 tons/year a custom made aerator-device was built. The sample of interest was agitated with air for 1 hour in ZnCl₂ (density of 1.7 g/cm³). After 2 days the valve in the top chamber was closed and ZnCl₂ was drained so the top chamber could be removed. The fluid from the top chamber was filtrated over a 10 µm steel sand filter prior to being disinfected by ultraviolet radiation. Effluents are used for irrigation in agriculture. Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical that thorough consideration of this exposure pathway and any resulting regulatory decisions are risk-based and made using robust evidence and science. Previous assessments of risks posed by contaminants in materials applied to land generally have several weaknesses. In the analysis: A. Vianello, such as sewage sludge, have not been made for the material directly prior to application to land and the assessments often have to make use of data from a different geographical locations and regulatory jurisdictions with mismatches in chemicals management policy. This project is seeking to address these issues on behalf of the Scottish Environmental Protection Agency by undertaking representative sampling and analysis of priority organic contaminants in a range of different organic materials that are frequently spread on land in Scotland. As a large number of organic compounds (in excess of 200) have now been identified in materials that are applied to agricultural land the first phase of this project has been to undertake a risk screening exercise. The purpose of this has been to identify organic chemicals likely to persist and/or bioaccumulate and to prioritise substances that are considered to pose a risk to human health or the terrestrial environment under reasonable worst-case assumptions for spreading. Results will be presented from the analysis of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land.
ZnCl₂ solution. All floating particles were collected and individually analysed under a light microscope. Selected particles looking like plastic was analysed on the ATR.

WE149 Novel Analytical Strategies for Anthropogenic Compounds in Plants: Vegetable Biomass as an Indicator for Sorption of Pharmaceuticals

R. Wahman, J. Grassmann, Technical University of Munich; P. Schroeder, Helmholtz Zentrum München / Microbe Plant Interactions; S. Bieber, Technical University of Munich / Chair of Urban Water Systems Engineering; T. Letzel, Technical University of Munich

Plants play an important role in the maintenance of life. Besides providing us with food, they are able of cleaning the environment, i.e., from compounds like diclofenac, which occur in waterbodies in concentrations up to µg/L levels. The assilitated compounds are not excreted by the plants but stored in vacuoles. This project will focus on whether plants can eliminate pollutants from the environment and whether plants are capable of metabolizing the pollutants and to detoxify them.

These two points already have been partially clarified in phytoremediation research. However, a major problem related to this kind of research is not concerning the plant metabolism pathways, although knowledge about those pathways, the involved enzymes and the resulting transformation products is essential. Thus, our major goal was to figure out whether the biological degradation pathways can be reflected by the analytical data obtained from polarity extended RPLC-HILIC-MS analysis.

There are several important research fields which give an original contribution to investigate the sorptive behavior of pollutants in leaf and fruit extracts of various plants. This study aims to contribute to this growing area of research by exploring new or modified secondary metabolites that appear after addition of pollutants. To the best of the authors knowledge, no research is available up to now that surveyed the changes in the plant metabolite pathways of constructed wetland plants (CWP). Moreover, along with growth in CWP, due to possibly accumulated contaminants the need for understanding of how these plants must be treated further, i.e. which points have to be considered regarding their disposal. We will provide a conceptual theoretical framework based on analysis of different plant extracts before and after exposure to different pollutants using novel RPLC-HILIC/ToF-MS technique. The plants were exposed in the laboratory to different pollutants. Initially, the prevalent diclofenac was chosen. After the plants reached their maturity, they were exposed to pollutants for a few days. To establish the concept at the beginning comparably high concentrations of pollutants were applied. Finally, we will be able to provide an open access database of plant metabolites (PHRAMITITES-IDENT) and implement it into an analytical platform constructed earlier (FOR-IDENT; see https://water.for-ident.org). This work is supported by the Bavarian State Ministry of the Environment and Consumer Protection.

WE150 Pharmaceuticals uptake by spinach from seven soils mixed with sewage sludge

R. Kodesova, A. Klement, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Golovko, University of South Bohemia in Ceske Budejovice / Institute of Hydrocenoses; J. Klement, Institute of Hydrocenoses; A. Nikodem, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses; M. Fer, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

This study was focused on a mobility of pharmaceuticals from sewage sludge in soils and their uptake by plants. Soil samples were taken from top horizons of seven different soil types (Stagnic Chernozem Silice, Haplic Chernozem, Greyic Phaeozem, Haplic Lavisol, Arenosol Epieutric, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sludge were packed in plastic columns, humidified to a value close to field water capacity and incubated under laboratory conditions. Next, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions. Finally, a ponded in plastic columns, humidified to a value close to field water capacity and 14 days incubated under laboratory conditions.

Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress (P)

WE152 Experiences of demonstrating aquatic plant recovery following herbicide exposure using sloped mesocosms

F. Pickerling, Cambridge Environmental Assessments

Recovery is important when considering short term exposure of aquatic non-target plants to herbicides in edge of field water bodies. Mesocosm studies allow the effects on both individual species and communities to be assessed simultaneously. Unlike indoor laboratory studies, where test item concentrations are artificially maintained, mesocosm studies allow for a more realistic application and dissipation of test item. Therefore, mesocosm studies can assess direct and indirect effects whilst a test item is present, and also monitor the period after dissipation has occurred to assess possible recovery. Using our sloped mesocosms at Cambridge Environmental Assessments (CEA), we are successfully able to test up to ten macrophyte species, each with different physical structures and characteristics (e.g. rooted; emergent). Some traditional measures of plant health can be seen as subjective (e.g. necrosis scoring and macrophyte mapping). At CEA, additional metric parameters such as number of nodes, number of leaves and stem lengths are routinely measured throughout the in-life phase. As a result, a combination of parameters are measured for each species tested. This ensures that the endpoints of a study are suitable robust and can be used to assess recovery. Here we will use results from our past studies to share experiences of assessing plant health. We will discuss which endpoints are most sensitive, reliable and therefore most suitable for determining effects on each plant species. Finally we will discuss which of these measurements are most relevant to assess recovery.

WE153 Impact of plant density on the end points (ER50) determined for crop protection products in Non Target Terrestrial Plants Studies conducted to OECD 227, Vegetative Vigour

E. Paterson, A. Thompson, Dow Agrosciences; G. Merceallii, Dow AgroSciences Italia s.r.l. / Etoxecnology; K. Ralston-Hooper, Dow Agrosciences; G. Karaiskou, AgroSciences Non Target Terrestrial Plant (NTPP) studies conducted to OECD 227 test guidelines are submitted as part of the registration process for plant protection products in Europe and the US. Current planting densities described in OECD test guideline 227 for Vegetative Vigour Studies, recommends 1-2 large plants per 15 cm by 15 cm square medium size species per 15 cm pot and 5-10 small species per 15 cm pot. The minimum recommended number of plants per treatment in OECD 227 is 20, as a result vegetative vigour studies conducted to this guideline, regularly exceed 750 pots. These studies require a large amount of glasshouse space and are very labour extensive. Establishing, spraying, assessing and handling data from such large studies has its own issues and can increase the probability of errors occurring during the testing phase which can be conducted in a given time frame; and increasing plant variability within the study making data interpretation more difficult. OECD 227 is a guideline and different planting densities, which are considered adequate to generate robust data, may be used. However it needs to be assessed whether these different planting densities in the pots can impact the final endpoints determined in the Vegetative Vigour studies and ultimately the risk assessment. It will be be for the industry to test species planted at three densities to evaluate any impact on the Vegetative Vigour Study endpoints (expressed as ER50 values) used in the risk assessment.
Interspecific competition impact on organisms responses to chemical stress : an SSD-based approach.

V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); C. SULMON, ECOBIO; CNRS UMR 6553, Université de Rennes 1 / UMR CNRS ECOBIO; A. BERNARD, LIEC (CNRS UMR 7360, Université de Lorraine); A. MONY, ECOBIO; CNRS UMR 6553, Université de Rennes 1; S. Devia, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; E. Billoir, Université de Lorraine, CNRS UMR 7360

Organisms are not alone in the environment. They interact with other individuals of the same or other species in different ways. Interspecific competition is an important interaction for herbaceous plants in grass strips. Such vegetated areas generally act as buffer strips against pollutant flows and are thus submitted to various chemical exposures. However, competition is rarely considered in environmental risk assessment. To address this point, we tested whether competition modifies the way plants respond to herbicide (isoproturon) toxicity in an attempt to link individual tolerance of organisms and community dynamic. Then we investigated the impact of competition on species sensitivity distribution (SSD), a widely used community-level risk assessment tool that usually considers monospecific bioassays only. To do so, we exposed during 25 days 6 herbaceous species (representing varied isoproturon tolerance and competition ability) to 6 isoproturon concentrations (0 to 1.75µM) in presence and absence of a selected competitor, Bromus erectus (choice based on its high resistance to isoproturon and its high competition ability). For each competition test, we tested 10 replicates were, e.g. by degree exposures, 10 different traits corresponding to morphological, biomass and physiological responses, as well as the response profile of 50 metabolites were quantified for aerial and underground plant parts, then representing respectively soft (easy to acquire) and hard traits. The consequent dataset generated was used to model plant responses depending on isoproturon concentration and competitor presence/absence. For soft traits, dose-responses curves were built for each species, in presence and absence of competitor for each endpoint to define (1) their sensitivity, (2) their relevance to assess toxicity, (3) how competition modify points (1) and (2). In parallel, metabolic data were treated the same way, using a workflow created to handle high-throughput dose-response datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

How to consider recovery of aquatic plants in risk assessment?

U. Hommen, Fraunhofer IME; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; H. Krueger, EAG Laboratories

Exposure of non-target plants to plant protection products or other stressors can be restricted in time. For each endpoints, several replicates were, e.g. by degree exposure or transport. In such cases, the plants might recover if the effects are reversible. Neglecting the recovery potential in the risk assessment is definitely protective but might be over-restrictive in certain for example unnecessary losses of crop yields. The recovery subgroup of the SETAC Plants Interest Group aims to review the different approaches to analyse recovery of plants and to make suggestions how recovery of these effects should be included in a risk assessment framework. In this presentation, we will focus on aquatic algae and macrophytes and the regulation of plant protection products in the EU. Experimentally, recovery of algae and macrophytes can be assessed in single species laboratory tests or micro- and mesocosm studies. In refined exposure laboratory toxicity tests, usually the recovery of the growth rate is assessed since the populations are kept in the experimental growth phase. In micro- and mesocosm studies, it is possible to analyse also recovery of abundance or biomass and potential indirect effects. The differences of these two options and their potential consequences for risk assessment will be discussed. Effect modelling can be used to extrapolate from empirical data to other exposure scenarios or species. However, while the simulation of refined exposure laboratory toxicity tests seems to be straightforward, the prediction of effects under field conditions is still challenging. In addition, the use of such models in the risk assessment requires clearer criteria on which magnitude and duration of effects can be considered acceptable.

Rimsulfuron toxicity and recovery in duckweed (Lemna minor) responses to chemical stress: an SSD-based approach.

M. Opincarne, University of Florida / School of Natural Resources and Environment; P.C. Wilson, Z. Li, University of Florida IFAS / Soil and Water Science

Rimsulfuron is an herbicide for which very little is known about its toxicity to aquatic macrophytes. This study was designed to evaluate the effects of rimsulfuron on the model aquatic macrophyte Lemna minor at low concentrations. This study also evaluated recovery by L minor following a 5 day exposure period. Growth rates were measured at 1, 3, and 5 days following exposure to rimsulfuron-fortified 10% Hoaglands media at concentrations of 0, 0.0003, 0.0006, 0.00125, 0.0025, 0.005, 0.01, and 0.02 mg/L. After 5 days exposure, growth rates were significantly lower for rimsulfuron concentrations ≥0.0006 mg/L. Following the 5-day exposure period, plants were rinsed with deionized water and placed in fresh Hoagland’s nutrient media. Impact on growth rate was measured as percent impact compared with growth of the control. Growth rates for 00006 mg/L were reduced 25.4% relative to the controls. Interestingly, a hormetic response was observed at the 0.0003 mg/L concentration. In this case, the growth rate was 6.7% relative to the control. Following exposure, significant reductions in growth rate were observed on days 3, 5, and 10. However, 15 days after removal from the rimsulfuron treatment solutions, growth rates recovered to control levels. While rimsulfuron exposure significantly reduced growth rates of L minor at all concentrations ≥0.0006 mg/L, effects were found to be reversible. Rimsulfuron was fast acting, with toxicity observed 1 day following exposure. In contrast, a longer period of time was required for growth rates to recover to control levels.

Toxicokinetic/toxicodynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants

S. Han, Bayer AG / Effect modelling; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; A. Solga, Bayer AG; T. Preuss, Bayer AG / Environmental Safety

For assessing the risk of plant protection products (PPP) to aquatic ecosystems, environmental concentrations of the active substance need to be estimated. Throughout Europe different approaches are used to predict these environmental concentrations. To characterize the toxicokinetics of a given substance in aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to an active substance over several days are compared to the predicted maximum environmental concentration. Although, it can be deemed conservative to only consider the maximum concentration, there are plenty of cases where the risk assessment becomes overly conservative due to this practice. This applies particularly to assessments for long-lasting substances (estrains) in which chronic exposure concentrations usually last for a few hours or days, only. Since some models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (exposure patterns), a more detailed and realistic assessment of exposure is possible. To also increase the realism on the effect side, either an ecotoxicological threshold from a refined exposure experiment is needed, or the effect of the predicted exposure pattern on the organism is investigated by ecological modelling. We propose TK/TD modelling as a powerful tool to evaluate effects of time variable exposure on aquatic plants. TK/TD modelling refers to linking effects to the internal concentrations in an organism instead of the external one and by this being able to consider time-variable exposure patterns. For characterizing risks of active substances by TK/TD modelling, it is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work, the toxicity model of a Lemna minor as aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to a reference substance by TK/TD modelling, is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work, the toxicity model of a Lemna minor as aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to a reference substance by TK/TD modelling, is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship.

Assessing soil toxicity of methylparaben using plants and collembola

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

Methylparaben is an endocrine disrupting chemicals (EDCs) and is contained in personal care products such as cosmetics and quasi-drugs. Methylparaben is known to have low toxicity to mammals, but there is no data on hazard assessment for soil ecosystem. Methylparaben was mostly removed in the sewage treatment process, but was detected in soils of various countries. In addition, there is a possibility that personal care products may leak into aquatic or soil environments if they are directly disposed in the environment without any treatment. Therefore, it is necessary to evaluate the hazard assessment of methylparaben in soil ecosystem. This study assessed the toxicity of methylparaben to plants (mung bean and rice) and collembola. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembola test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive endpoint in mung bean was identified as stomatal opening size, and no observed effect concentration (NOEC) was 10 mg/kg. The most sensitive factor in rice was chlorophyll contents, and NOEC was under 10 mg/kg. The half lethal concentration (LC50) value for collembola was 440.53 mg/kg. Methylparaben appears to have significant physiological effects on plants even at low concentrations. The results of this study can be fundamental for soil risk assessments of methylparaben. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Science

SETAC Europe 28th Annual Meeting Abstract Book
WE159
Evaluation of phytotoxicity for Bisphenol A with new endpoint, phytoestrogen
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

We developed two new endpoints for endocrine disruptors (EDCs) that are known as chemicals that show hormone-like action or inhibit hormones, the phytotoxicity assessment of EDCs does not have any specific toxic endpoints for these substances. The factors (growth, photosynthetic activity, chlorophyll, etc.) used to evaluate common toxic substances such as heavy metals are also applied to EDCs. These factors are not suitable for EDC materials, which have relatively low toxicity to organisms, and phytoestrogen, which is an estrogenic hormone associated with hormones, takes a long time to assess toxicity. Therefore, we tried to evaluate phytoestrogen, a new toxic endpoint for EDC materials, using bisphenol A. Meanwhile, bisphenol A is known as a representative EDC used in the production of consumer products and in various industrial fields. While it is used widely for various purposes, the soil ecotoxicity of bisphenol A is limited. Therefore, we evaluated the toxicity of bisphenol A (at 1, 10, 100, and 500 mg/L) using the phytoestrogen assessment and evaluated the applicability of phytoestrogen, a new endpoint for EDC materials. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and funded by the Graduate School of Specialization for managing information related to chemical risk.

WE160
Soil toxicity of DEHP and Nonylphenol on mungbean and rice
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

DEHP is used as a plasticizer and insecticide. Especially, it can be used as plastic vinyl applied in farmland. Nonylphenol is used as surfactant, and 4-nonylphenol is mainly used as plasticizer with various isomers which are used as insecticide and detergent. Although DEHP and nonylphenol are likely to release into the soil environments, soil ecotoxicity data are currently limited. Ecotoxicological researches in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in 14 days-acute experiment and physiological factors including stomata opening size, chlorophyll contents, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the soil toxicity of the two substances to the plants was conducted using various factors, and the results of this study can be fundamental for soil risk assessments of DEHP and nonylphenol. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

WE161
Toxicity of a glyphosate based formulation on phytoplanktonic green microalgae
J.G. Perez, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Biodiversidad y Biología Experimental, Buenos Aires; A. Magdaleno, Universidad de Buenos Aires / Facultad de Medicina y Bioquímica, Cátedra de Salud Pública e Higiene Ambiental; M.d. Ros de Molina, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica, CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN); A.B. Juarez, Universidad de Buenos Aires / Facultad de Ciencias Exactas y Naturales, Departamento de Biodiversidad y Biología Experimental

The emergence of transgenic crops led to an increase in the use of glyphosate and its presence in different ecosystems is a worldwide problem. Although it was designed to inhibit the aromatic amino acids synthesis in plants, glyphosate exerts toxic effects on non-target organisms, probably through other mechanisms. Its entry into water bodies is a risk for biota, particularly for the phytoplankton microalgae. Glyphosate is described in the OECD 239 guideline can be adapted to include measurements of toxic phytoplanktonic green microalgae. Cultures of Scedesmus acutus, Anakistrodesmos fusiformis, Monoraphidium contortum and Parachlorella kessleri were exposed to increasing glyphosate concentrations (0 – 75 mg glyphosate/L) and kept at 24 ± 1 °C, under continuous agitation and illumination. After 96 h, growth, IC50, chlorophyll a content and oxidative stress parameters of 4 phytoplanktonic green microalgae were evaluated. Cultures of Scedesmus acutus, Anakistrodesmos fusiformis, Monoraphidium contortum and Parachlorella kessleri were exposed to increasing glyphosate concentrations (0 – 75 mg glyphosate/L) and kept at 24 ± 1 °C, under continuous agitation and illumination. After 96 h, growth, IC50, chlorophyll a content and oxidative stress parameters were evaluated. The glyphosate caused a significant decrease of chlorophyll a in M. contortum and P. kessleri, but not in the other two species tested. The growth of the 4 strains was negatively affected and regarding the IC50 values M. contortum was the most sensitive strain (3.37 mg/L), followed by A. fusiformis (6.50 mg/L), S. acutus (14.74 mg/L) and P. kessleri (41.75 mg/L). In order to evaluate the relationship between antioxidant defenses and sensitivity, we analyzed parameters of oxidative stress in the least and the most sensitive strains. The exposition to 2-4 mg glyphosate/L in M. contortum and 30-75 mg glyphosate/L in P. kessleri, caused increases of reactive oxygen species, lipid peroxidation (TBARS), reduced glutathione, superoxide dismutase, and glutathione transferase. The level reached of TBARS in P kessleri was 10 times lower than in M. contortum, while the levels of antioxidant defenses were 3.5 – 7 times higher. These results suggest that oxidative stress would be involved in the toxicity of the glyphosate formulation and that the differences in sensitivity between strains could be due to differences in their defense antioxidant levels. According to the EU Directive 93/67/ECC, the IC50 values estimated indicate that the glyphosate formulation assayed should be toxic for aquatic biota. Besides, results also warn about its possible effects on the composition of phytoplankton, which would put at risk the balance of the aquatic ecosystem.

WE162
Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment
G. Meregalli, Dow AgroSciences Italia s.r.l. / Ecotoxicology; C. Vaj, V. Zaffagnini, A. Carone, Dow AgroSciences Italia srl

Indicator species are the basis of the ecological risk assessment framework. Endpoints derived for these species are used in the risk assessment to evaluate the safety of, e.g. plant protection products (PPP) to non-target species. In certain cases indicator species are also indigenous species to a particular region (e.g. Myriophyllum spicatun in Europe). Invasive species are non-autochthonous species, accidentally introduced in a given region, which, in absence of their natural predators, often grow uncontrolled and overcome indigenous species, completely devastating the biodiversity of the habitats they colonise. The uncontrolled growth of these species can be also a threat to ecosystem functioning, e.g. altering oxygen balance in the case of the aquatic environment or shifting the prey/predator equilibrium. In cases where other control means are not possible, PPP could be employed to control the spread of invasive species. As an example, in the USA some herbicides have been authorised to control M. spicatun, which is an invasive alien species in North America. On the other hand, recently in Europe there have been reports of Myriophyllum aquaticum, a new alien invasive species genetically related to the indicator M. spicatun. In Piedmont (Italy), M. aquaticum has been observed in the Po River, threatening aquatic biodiversity. In addition also rice cultivation, a very important crop for the region, is at risk, due to the uncontrolled growth of M. spicatun: canals and ditches feeding water to rice paddies. This species has been added as an invasive species to the black lists of Piedmont and of the European Union and it is being monitored and controlled with local initiatives. To prevent the irreversible degradation or destruction of natural habitats by non-autochthonous species, a timely intervention may be necessary, even if this may result in a temporal impact on indigenous desirable species. Programs to manage invasive species need to be based on the presence of alien species. The use of a risk-benefit analysis, which can help in the decision of whether PPP are suitable for use in such programs, will be discussed in light of the two abovementioned examples.

WE163
Auxinic herbicides: the impact of water plants’ root measurements on the risk assessment
G. Gensier, Eurofins AgroSciences Ecotoxicology GmbH

Data requirements for the registration of plant protection products in the EU Regulation 1107/2009 indicate that a test on a Myriophyllum species is necessary for auxinic herbicides. The OECD 239 water sediment test with Myriophyllum species has been developed and used for many years and is still considered comparable to natural conditions. In this testing methodology, shoot length, as well as, fresh and dry weights need to be recorded. The OECD 239 guideline requires that only a qualitative assessment of the roots is undertaken. Auxinic substances are known to exert their herbicidal activity by affecting growing tissues. As such, roots of Myriophyllum plants may be affected after exposure to auxins. The methodology described in the OECD 239 guideline can be adapted to include measurements of fresh and dry weights for whole plants, rather than just the shoots, thereby assessing, indirectly, also possible effects on the roots. However, it needs to be evaluated if an indirect quantitative assessment of the roots in the Myriophyllum studies with auxinic substances would result in significantly different endpoints that would be necessary to be included in the risk assessment of auxinic substances. Results will be presented to clarify if effects on the roots in a water sediment system are providing additional information relevant for the risk assessment.

WE164
Testing the emergent macrophyte, Glyceria maxima in a water-sediment system : Results of a ring-test with Isoproturon
J. Davies, Syngenta / Environmental Safety; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; K. Kuhl, Bayer AG - Crop Science Division; J. Kubitz, BASF. M. Ratte, ToxRat Solutions GmbH & Co. KG

Under EU pesticide regulation, regulatory tests are required for the approval of new plant protection products (PPP). In general, PPP are required for the control of weeds or invasive species. A subset of these substances, the auxinic herbicides, are known to exert their herbicidal activity by affecting growing tissues. As such, roots of Myriophyllum plants may be affected after exposure to auxins. The methodology described in the OECD 239 guideline can be adapted to include measurements of fresh and dry weights for whole plants, rather than just the shoots, thereby assessing, indirectly, also possible effects on the roots. This is done by testing, on the one hand, a known root bioassay which is a standard test for the majority of PPP to assess the potential risk to roots. The new methodology described in this paper allows for the testing of a range of plant growth regulators in an aquatic environment using the root growth bioassay. Further, plant growth regulators, a chemical class which is often illegally used for uncontrolled aquatic weed management, can be tested on the emergent macrophyte, Glyceria maxima, which can be used as an indicator species for the presence of aquatic weeds. This paper presents the results of a ring-test conducted by the Animal and Plant Health Agency to test the auxinic herbicide, Isoproturon. Isoproturon is an auxinic herbicide that complies with the OECD 111 test guideline. Two different laboratories tested Glyceria maxima under natural conditions, without significant deviations in the test results. The results indicate that Glyceria maxima is sensitive to Isoproturon, which is in line with the results obtained for Myriophyllum aquaticum in the OECD 239 guideline. In the near future, this new methodology will be utilised to assess the potential risk to roots of different plant growth regulators. The new methodology will be integrated into the regulatory test guidelines to provide a better support for the hazard assessment of new plant protection products.
are Myriophyllum and Glyceria, respectively. OECD Test Guideline 239 for testing Myriophyllum spicatum in a water-sediment system was adopted in September 2014 and this test method has since been adapted to facilitate growth of the emergent, reed grass, Glyceria maxima. During 2016 and 2017, 15 laboratories participated in a ring-test with the herbicide, isoproturon against Glyceria. The objectives of this test were to establish suitable test conditions, to determine the required test duration, to characterize control variability and inform test design and to identify appropriate validity criteria. Results of this ring-test will be presented alongside progress on a second ring-test with the herbicide imazaquirim, scheduled for Spring / Summer 2018.

**WE165**

*Study of the toxicity effects of Cd, Ni and Zn on macrophytes, antioxidant responses and time for steady-state bioaccumulation under constant metal concentrations exposures*

S. martinez, CONICET PRIET UNTU; M. Saenz, PRIET CONICET, National University of Luján; W. D. Di Marzio, CONICET-PRIET / PRIET

Heavy metals represent an actual environmental problem because the industrial and commercial uses of them are continuously increasing, bringing on a widespread contamination. Examples of human activities that contribute in heavy metal contamination are mining, smelting, fossil fuel combustion and industrial applications. Human activities may also indirectly cause changes in the environment that mobilize metals that were otherwise bound in stable forms, making them bioavailable. Aquatic bodies directly or indirectly receive pollutant discharges and metals, which in water are easily adsorbed by macrophytes. This study was aimed to evaluate the individual toxicity effect of Cd, Ni and Zn on a macrophyte and its bioaccumulation capability. Cadmium is a hazardous environmental pollutant and is toxic to most organisms. Nickel and Zinc are essential trace elements needed in the nutrition of plants. Nevertheless, over certain threshold they can present phytotoxic activity. Macrophytes are key elements in aquatic ecosystems, linked with the cycling of nutrients and phosphorus. *Ceratophyllum demersum*. Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-6 Ni, 4-64 Zn or 0.5-8 Cd mg/L) and fresh weight, main shoot length and total shoot length were chosen as endpoints. For the bioaccumulation assays, plants were exposed to a constant metal concentration techniques, to period of time until internal metal concentration reached a steady state. To make sure of a constant external metal concentration, a daily renewal of the media was carried out. Besides, the influence of these metals on antioxidative enzymes activity was evaluated for the three lower concentrations of each one. These enzymes are involved in the plant defense mechanisms activated by heavy metal exposure. Determination of catalase (CAT), glutathione peroxidase (GPx) and ascorbate peroxidase (APX) activities were performed from the total plant mass. In the main, fresh weight resulted in the most sensible endpoint reaching an inhibition of almost 50% for 64 mg Zn/L and presenting significant inhibition for concentrations higher than 2 mg Ni/L and 1 mg Cd/L. Cd exposed plants over 1 mL presented signs of chlorosis and disaggregated easily at the higher concentrations. Metal uptake reaches the steady-state between days 11-14 in all cases. CAT activity at test concentrations remained near control values, while APX and GPOX enzymes showed an increase indicating possible sublethal effects.

**WE166**

*Physiological responses of Thlaspi praeox (Brassicaceae) to Ni hyperaccumulation*

T.D. Mišlenović, K. Jakovljević, S. Jovanović, University of Belgrade / Faculty of Biology Institute of Botany and Botanical Garden Jevremovac; N. Mihailović, University of Belgrade / Institute for the Application of Nuclear Energy; V. Maksimović, University of Belgrade / Institute for Multidisciplinary Research; D. Mišić, University of Belgrade / Institute for Biological Research Siniša Stanković Thlaspi praeox is a well known heavy metal hyperaccumulating plant species. The ability of *T. praeox* to hyperaccumulate Zn and Cd have been extensively studied, while data on Ni hyperaccumulation are scarce. Our aim was to bring more understanding to the physiology of *T. praeox* exposed to increasing concentrations of Ni. Seeds of *T. praeox* were collected from an ultramafic site on Mt. Maljen (Serbia). Two - weeks old seedlings were planted to a peat based substrate amended with increasing concentrations of Ni (250, 500, 1000 ppm). Plants were grown for 3 months under controlled conditions. Content of Ni in plants was analyzed by AAS, while phenolics, sugars and organic acids have been analysed using UHPLC/DAD/MS® or HPLC-PAD. No visible toxicity symptoms were observed during plant growth, and Ni did not affect biomass production at applied concentrations. A dose-dependent response of *T. praeox* shoots to applied Ni concentrations was recorded. Ni hyperaccumulation threshold of 1000 ppm was exceeded in the shoots at all treatments, and the highest Ni content was 6786 ppm. Calculated values of translocation factor (shoot/root ratio of Ni concentration) above 10 in all Ni treated groups indicated active translocation of Ni from roots to the shoots. At the highest applied Ni concentration, statistically significant reduction of total chlorophyll content and carotenoids were observed. Contents of phenolic acids and flavonoids were generally low, and were not significantly affected by increasing Ni concentrations. Effects of increasing Ni concentrations on the content of sugars and organic acids in shoots have also been analysed. Understanding the physiology of *T. praeox* exposed to Ni and its’ Ni tolerance limits might be relevant for the potential application of this species in phytostabilization or phytorextraction technologies at contaminated soils.

**WE167**

*Phytoextraction of heavy metals in Cienega of Tamasopo wetland, México, by Typha latifolia C. Wong, C. Carranza, Universidad Autonoma de San Luis Potosi / Laboratorio de ciencias ambientales; A.J. Alonso, Universidad de Guanajuato / Departamento de Farmacia*

Heavy metals are persistent inorganic toxic pollutants that come from diverse anthropogenic activities [1]. They can be easily absorbed by the roots of plants due to their relatively high mobility in the soil, making them known to have great importance, forming a substantial component of the primary production in many aquatic ecosystems, especially in wetlands. Plants can remove and accumulate metals from the solution by phytorextraction; however, the metals can also be precipitated or eliminated from the solution by ion exchange or by adsorption on organic and inorganic compounds. Concentrations of heavy metals in aquatic plants depend both on metal speciation and on the species of plant absorbing the metal [2]. High concentrations of some trace metals in aquatic plants have led many authors to believe that they accumulate from water and/or from sediments; the uptake is influenced by several factors, such as temperature, pH, light and the presence of other metals in the water, all of which alter the uptake of heavy metals into the tissue [3]. Metal uptake by plants has three patterns: (1) true exclusion in which metals are irreversibly entered from the plants; (2) shoot exclusion, in which metals are accumulated in the root but translocation to the shoot is restricted; and (3) accumulation, where metals are concentrated in the plant parts [4]. The present research examines the phytorextraction in situ of heavy metals by *Typha latifolia* to determine the concentration of these metals in the plant, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega of Tamasopo where the aquatic vegetation was free and the soil was composed by *Ceratophyllum demersum*. 2) samples of 5% acidified water with HNO3, and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 °C for 18 hours in Lindberg / Blue stone; 3) grinding and spraying of root and leaves in analytical mill (KIKA Werke M20); 4) acid digestion with HNO3 in plate at room temperature in root and leaves [5] and sediments; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that *Typha latifolia* accumulate Mn>Zn>Cr>Pb>Cu>A>Hp>Cd in roots. This study aimed to gain a better understanding of the importance of aquatic plants such as *Typha latifolia* in heavy metal accumulation and detoxification mechanisms.

**WE168**

*Heavy metal removal by aquatic plants*

M. Saenz, PRIET CONICET, National University of Luján; J. Alberdi, priet conicet uni; s. martinez, CONICET PRIET UNTU; s. curies, priet conicet uni; W. D. Di Marzio, CONICET-PRIET / PRIET

Removal of heavy metals from environment due to industrialization and urbanization is a great problem worldwide, due to their toxicity to many life forms. Aquatic waste from metal plating, mining operations, tanneries, smelting, alloying industries, and storage batteries are sources of metal contamination. Biological methods have been recommended as and effective alternative for removal and recovery of heavy metals from aqueous solutions. Aquatic plant biomass represents an important biological adsorbent and can be used to accumulate heavy metals and therefore have been exploited worldwide in the field of wastewater treatment technologies. Aquatic plant species including free floating and submerged, as *Lemma, Spirodella, Ceratophyllum* and *Myriophyllum*, have shown potential for metal removal from wastewater. The aim of this study is to evaluate the efficiency and capacity of different species of aquatic macrophyte in metal removal. The present research examines the phytoextraction in situ of heavy metals by *Typha latifolia* to determine the concentration of these metals in the plant, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega of Tamasopo where the aquatic vegetation was free and the soil was composed by *Ceratophyllum demersum*. 2) samples of 5% acidified water with HNO3, and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 °C for 18 hours in Lindberg / Blue stone; 3) grinding and spraying of root and leaves in analytical mill (KIKA Werke M20); 4) acid digestion with HNO3 in plate at room temperature in root and leaves [5] and sediments; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that *Typha latifolia* accumulate Mn>Zn>Cr>Pb>Cu>A>Hp>Cd in roots. This study aimed to gain a better understanding of the importance of aquatic plants such as *Typha latifolia* in heavy metal accumulation and detoxification mechanisms.
WE169
Toxicity of the binary mixture Cd-Zn on Lemna gibba evaluated using morphological and oxidative stress enzyme endpoints
s. martinez, CONICET PRIET UNU; W.D. Di Marzio, CONICET-PRIET / PRIET; M. Saenz, PRIET CONICET, National University of Luján
The presence of metals in the environment represents one of the major concerns as they are persistent in nature, non-biodegradable and can bioaccumulate in living aquatic systems. Plants, due to their production of energy rich biomass at a trophic level composed partly by aquatic vascular plants, also called macrophytes. These organisms play a critical role in this environment. As a representative species of macrophytes, we worked with a rooted free-floating Lemna gibba. The metals evaluated here were Cd and Zn, individually and in mixtures. Exposures of plants were carried out in presence or absence of Cd and Zn for 7 days. Different endpoints were determined at the end of the assays. Number of fronds, fresh weight, fronds/colonies ratio, frond area and exes’ length were the determined morphological endpoints. Physiological changes were evaluated as enzymatic activity of catalase, ascorbate peroxidase and guaiacol peroxidase, determined at the lowest concentrations. Both metal concentrations, bringing about a 50 % inhibition of root number (EC50) was determined. In order to compare the sensitivities of the different endpoints, NOEC and LOEC toxicity indexes were calculated. For Cd, fresh weight and fronds/colonies ratio resulted in the most sensitive, while for Zn total area was the most sensitive. Even though there wasn’t any significant difference for guaiacol peroxidase activity for Cd, it presented an increase compared to control. While the other enzymes had activity levels similar to the control. In the case of Zn, catalase and ascorbate peroxidase activities were higher, however neither of both presented significative differences with it. For the mixture analysis, multiple regression was used to fit the observed %frond number inhibition (%FNI) to dissolved metal concentration (M(t)). The negative value of the parameter of the interaction between Cd and Zn indicates alleviation of %FNI and toxicity. The concentration addition approach was evaluated by calculating the sum of the individual toxic effect (ΣTU) for each single EC10 and analogous for the mixture (ΣTU). The results showed that this mixture presents an additive toxicity to Lemna gibba. Enzyme activity was also calculated at the lower concentrations of the mixtures. In general an increase in the enzymatic activity was observed. Ascorbate peroxidase and guaiacol peroxidase presented the maximum increase, while catalase had a moderated activity rise.

WE170
Increase of tolerance of green algae as a tool in metal bioremediation
M. Saenz, PRIET CONICET, National University of Luján; F. Cassani, S. Martinez, s. curistes, J. Alberdi, CONICET PRIET UNU; W.D. Di Marzio, CONICET-PRIET / PRIET
Presence of various metals in aqueous streams arising from the discharge of untreated metal containing effluents into water bodies, is one of the most important environmental issue, as human health risks and harmful effect to living organisms occur. In the last decades the amount of Chromium in aquatic and terrestrial ecosystems has increased as a result of different human activities such as mining, chrome plating, leather tanning and production of fertilizers (ie amounts of metal that can be used), to evaluate the use of preadapted strains to sublethal concentrations of Chromium, into bioremediation of Chromium containing wastewater. Preliminary results will be shown related to the assessment of the potential of this strategy to increase tolerance of selected species in order to become an interesting tool in the field of bioremediation processes mediated by green algae. Two green algae species were used, Scenedesmus quadricuada and Synechocystis sp. Water soluble and Nanoparticle species differ in its morphological structure and organization level as the former has a cenoidal feature while the second a free unicellular one. Both strains were maintained by a year under sublethal concentrations of chromium ranging from 0,42 to 1,73 mg/l. These concentrations were chosen base on previous experiments through range finding tests. Sublethal solutions were renewed monthly and algal populations recruited in the rhizosphere that can be more or less sensitive to NPs. For the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combinations of mixture were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus albus and Avena juncea, had EC50 and/or EC10, in at one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. junccea (73.07%), P. glaucum (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 78.61% and 85.91%, respectively. The proportions 87.32% and 40.61% of waste affected 50% of the length of the longest root of C. junccea and P. glaucum. The results showed that: the species tested presented different indices to soil fertility by mining waste; the activity of some enzymes of the plants increased causing phytotoxic effects in all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE172
Mitigation of CuO nanoparticles microbial ecotoxicity by plant in an agricultural soil: plant variety matters
J.M. Martins, IGE UMR 5001 / Université Grenoble-Alpes; A. Cantarel, Université Claude Bernard Lyon 1 / UMR Ecologie Microbiène 5557; J. Gervaix, Université Claude Bernard Lyon 1 / UMR Ecologie Microbiène 5557; A. Richaume, Université Claude Bernard Lyon 1 / UMR Ecologie Microbiène 5557
New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary treatments. However, they can generate soil contamination by metal-oxide NPs such as CuO-NPs which fate and impact on agro-ecosystems is still largely unknown. Several studies showed the deleterious effects of metal nanoparticles (NPs) on soil microbial communities and reported the importance of plant variety (OM) and ecotoxicty (OM + NPs) in the tolerance of mixtures. In this study, the species tested presented different indices to soil fertility by metal contamination; the activity of some enzymes of the plants increased causing phytotoxic effects in all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE173
Ecotoxicological assessment of the iron mining waste from Mariana (Brazil) on terrestrial flora using different plant species
O.R. Alves, University of São Paulo USP / Department of Hydraulic and Sanitation; O.A. Bandeira, T.J. Pinto, L.P. Figueiredo, University of São Paulo USP; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation
In Brazil it is very common to have mining waste placed in dams, especially in the Minas Gerais state. The deposit of mining wastes implies in risk of dam rupture, between other problems. In November 2015, the rupture of the “Fundão” Dam in the city of Mariana in Minas Gerais state was one of the worst environmental disasters in Brazil. The rupture caused severe impacts to the terrestrial and aquatic environments, where tons of the waste has been placed. It is now matter of concern to study the effects of the mining waste deposition in soil to terrestrial flora in order to understand the real consequences to the environment and so be able to propose actions for restoration and management of the affected area. The main goal of this study was to evaluate the ecotoxicity of the mining waste that outpaced the Fundão dam to ten different plant species (Avena striosa, Pennisetum glaucum, Croataria juncea, Canavalia ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed the OECD procedure to test the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combination of mixtures were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus albus and Avena juncea, had EC50 and/or EC10, in at one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. junccea (73.07%), P. glaucum (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 78.61% and 85.91%, respectively. The proportions 87.32% and 40.61% of waste affected 50% of the length of the longest root of C. junccea and P. glaucum. The results showed that: the species tested presented different indices to soil fertility by mining waste; the activity of some enzymes of the plants increased causing phytotoxic effects in all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE174
Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure
G. Molendo, ISPIRA-Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; A. Cicero, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; F. Onorati, ISPRA Institute for Environmental Protection and Research; Claude Bernard Lyon1 / UMR Ecologie Microbiène 5557
New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary treatments. However, they can generate soil contamination by metal-oxide NPs such as CuO-NPs which fate and impact on agro-ecosystems is still largely unknown. Several studies showed the deleterious effects of metal nanoparticles (NPs) on soil microbial communities and reported the importance of plant variety (OM) and ecotoxicty (OM + NPs) in the tolerance of mixtures.
and to its capability to accumulate certain environmental metal pollutants, would be a potentially valuable bioindicator species of metal pollutants. Mercury represents one of the most abundant marine pollutants in the Mediterranean Sea. This study subtelal effects of this metal were investigated in P. oceanica. Several foliar shoots of this aquatic plant were treated for 4 days (96 h) with different mercury concentrations (0, 0.1, and 1 μg L−1 Hg Cl2) under constant laboratory conditions.

Biometrical markers of oxidative stress (ROS) and antioxidant capacity, such as the glutathione S-transferase activity, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the micrornuclei frequency were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the midrib and the sheaths for genotoxic effects. Although a limited effect of Hg was measured in analyzed tissues, a significant difference in localization of responses was found in leaves of all treatments.

WE174 Influence of tolune vapor exposure on plant metabolic changes
W. Kim, J. Park, Gwangju Institute of Science and Technology / School of Earth Sciences and Environmental Engineering; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

The conventional damage methodology for plants after chemical accident only relied on the change in their phenotype such as leaf-bronzing, so there had been lots of controversy because of uncertain causality and inaccuracy. The ministry of environment tried to characterize of plant damage by introducing metabolomics. In this study, we applied the metabolomics method. However, target metabolite selection process was unclear and the exposure method did not reflect the chemical accident scenario, so the research results have not been put to practical use. Therefore, targeted metabolomics and vapor exposure chamber were introduced in this study to overcome the limitations of existing research. The development potential of metabolomics-based damage diagnosis tool was validated using Parietaria judaica, and Horsetail alpium. Toluene was selected as target compound based on the scoring system, which takes into account both accident frequency and hazards. To reflect the realistic chemical accident scenario, plants were exposed in vapor exposure chamber. In this study, the metabolomics responses of plants at early development stages (4th leaf stage) to toluene were evaluated by liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QToF-MS) based targeted metabolic profiling. The exposed concentration-based and recovery time-based metabolic response patterns were analyzed by Principal component analysis and Partial least squares Discriminant Analysis. Overall, the results of multivariate statistical analysis demonstrated a number of potential biomarkers that were characterized by metabolic approach and provided an insight into quantitative chemical accident damage assessment.

WE175 Influence of soil organic amendments on the phenolic contents in rosemary (Rosmarinus officinalis) L. plants
I. Nogues, National Research Council of Italy / Institute of AgroEnvironmental and Forestry Research; F. Poromaa, National Research Council of Italy / Institute of AgroEnvironmental and Forestry Research; Water Research Institute; P. Gremi, National Research Council of Italy (CNR) / Water Research Institute; M. DE LOS ANGELES BUSTAMANTE MUNOZ, University Miguel Hernández de Elche (Spain) / Department of Agrochemistry and Environment

Rosemary (Rosmarinus officinalis L., Lamiaceae) is an aromatic shrub native from Mediterranean region and grown as a common herb around the world. This species constitutes an exceptional source of different bioactive compounds, mainly phenolic compounds, with proved antimicrobial and antioxidant activity. Furthermore, different studies have shown the potential and important role that this shrub can have in the rehabilitation of degraded soils such as agricultural ones with low levels of organic carbon, contributing to the reduction of erosion and improving soil quality. Within this context, different studies have shown that the metabolism of the phenolic compounds in plants has been associated to environmental factors, such as temperature, rainfall and ultraviolet radiation incidence, as well as soil composition. In this sense, plant nutrient balance in the soil could influence the production of secondary compounds, the concentrations of secondary metabolites in plant tissues depending on the concentrations and availability of nutrients in the soil. Therefore, this study evaluates the effectiveness of the rosemary plant to improve soil quality and the effect of the incorporation of two composts derived from anaerobic digestates on the phenolic contents of rosemary plants grown a semiarid soil. In the study, two composts (CM, mainly composed by cattle manure anaerobic digestate and CS, mainly composed by pig slurry anaerobic digestate) at two different rates (30 t/ha and 60 t/ha respectively) were incorporated into a semiarid soil from central Italy. These organic amendments were compared with the soil without amendment (control treatment, B) and an inorganic treatment (l). Subsequently, plants of rosemary (Rosmarinus officinalis) were planted on those soils. The efficiency of the treatments was evaluated by analysing chemical characteristics in the soil and the total contents of phenolic compounds and flavonoids in the rosemary plants grown in the different treatments. The results obtained have shown that the incorporation of the organic amendments into the semiarid soil improved soil characteristics, by increasing organic matter and nutrient contents, but also implied a decrease in the concentrations of phenolic compounds in the rosemary plants, probably due to the nitrogen fertilisation increases growth, but also leads to decreased concentrations of carbon-based secondary metabolites, such as phenolic compounds.

WE176 Leaf litter originating from trees treated with systemic fungicides - a new exposure pathway for freshwater systems
K. Newton, University of Montreal; J.P. Zubrod, D. Englert, University of Koblenz-Landau / Institute for Environmental Sciences; S. Liederwald, Universität Koblenz-Landau / Institute for Environmental Sciences; T.C. Schell, IMDEA Water Institute / Ecotoxicology; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; M. Konschak, University Koblenz-Landau / Institute for Environmental Sciences; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Leaf litter decomposition, an important process in freshwater ecosystems, is mediated by microbial decomposers and leaf-shredding macroinvertebrates. This process can, however, be modified by chemical stressors such as fungicides. Although fungicide stress has increasingly been assessed in recent years, the systemic nature of some fungicides, which enables the uptake and distribution within treated plants, is not yet considered. Therefore, as a first step, we treated Alnus glutinosa with a mixture of systemic fungicides (SFs; azoxytrobin, cyprodinil, quinoxyfen and tebuconazole) via soil drenching at three levels (control, field application rate (FR), and 10 times the field application rate (FRx10)). During leaf fall, we collected the leaves and assessed the potential impact of the fungicides on microbial decomposers and leaf-shredding macroinvertebrates. We quantified microbial leaf litter decomposition, their community composition and the palatability of leaves after microbial conditioning for the model shredder Gammarus fossarum Koch. By assessing growth and physiological fitness of this species over multiple weeks, we additionally estimated the nutritional quality of leaf litter. Gammarids preferred conditioned FRx10 over control leaves, which may reflect changes in microbial community structure. This increase in palatability as a consequence of SF may be related to the fungicides’ ability to reduce fungal pest pressure, allowing trees to divert energy and carbon from defense to growth or storage. The same treatment resulted in a 300% increase in gammarid growth, while the underlying mechanism is still not fully understood.

WE177 SETAC Plants Interest Group
S. Loutsi, DuPont De Nemour Hellas S.A.

Environmental Risk Assessment in Sediments (P)

WE178 Benthic invertebrate bioturbation activity determines species specific sensitivity to sediment contamination
M. de Baat, University of Amsterdam / IBED-FAME; T.V. van Meer, University of Amsterdam IBED-Institutes / Department of Freshwater and Marine Ecology; P. Verdonschot, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME

Bioturbation activity of sediment-dwelling organisms promotes the release of contaminants across the benthic-pelagic ecosystem boundary, thereby affecting the exposure to and uptake of sediment associated contaminants at the sediment-water interface by themselves and the entire community around them. This way, bioturbation activity may contribute to species specific sensitivities to sediment associated compounds. Therefore we assessed if invertebrate bioturbation activity determines species specific sensitivities to sediment contamination. For two metals, Ni and Cu, sufficient data were available to construct Species Sensitivity Distributions (SSD). The position of the species in the SSDs could indeed be linked to their bioturbation rate: the most active bioturbators being the most sensitive benthic invertebrates. Active bioturbators thus enhance their exposure and therewith their sensitivity to sediment associated toxicants. Moreover, active bioturbators can hence promote the release of sediment-associated contaminants across the benthic-pelagic ecosystem boundary, thereby stimulating delivery of contaminants from what is often the most polluted environmental compartment in freshwater ecosystems. It is concluded that trait based ecotoxicology offers a possibly potent tool for predicting sensitivity of benthic invertebrates and the benthic community to sediment-associated contaminants.

WE179 Effect based sediment quality assessment incorporating chemical fingerprinting
N. Wieringa, University of Amsterdam/IBED Institute / FAME; M. de Baat, University of Amsterdam / IBED-FAME; B. van Hall, F. Selhorst, University of Amsterdam / Department of Freshwater and Marine Ecology; S. Droge, University of Amsterdam/IBED Institute / IBED; M. Kraak, University of Amsterdam / IBED-FAME; P. Verdonschot, University of Amsterdam / Department of
Freshwater and Marine Ecology
The European Union Water Framework Directive does not require member states to monitor sediment quality. When performed at all, water authorities most often monitor sediment quality by means of chemical target analysis focusing only on target compounds, potentially overlooking ecotoxicological risks caused by (un)known mixtures of sediment associated compounds. Hence, there is an urgent need to incorporate effect-based monitoring and chemical fingerprinting into sediment quality assessment. Therefore, the aim of this study was to innovate ecotoxicological sediment quality assessment by incorporating whole sediment bioassays and chemical fingerprinting of bioavailable compounds. To this purpose intact whole sediment cores were collected using a sediment core sampler at a reference and 11 contaminated sites grouped by land use: urban, agricultural, and WWTP (Wastewater Treatment Plant) sites. A Chironomus riparius 28-day life cycle whole sediment bioassay was performed with survival and emergence as endpoints. Simultaneously, SMPE fibers were applied as sediment passive samplers to determine pore water concentrations of phenanthrene and pyrene, selected as model compounds for sediment PAF concentrations. Survival in the bioassay was unaffected at the urban sites, while significantly lower at all WWTP sites and two of the agricultural sites. Emergence was significantly delayed at the urban sites, agricultural sites exhibited an irregular emergence time, while WWTP sites induced accelerated emergence. Pyrene and phenanthrene concentrations were negligible at the reference site, very low at the agricultural and WWTP sites, and highest at the urban sites. Urban sites thus have a high chemical load, but survival was higher than on the agricultural sediments. Contrastingly, agreement between WWTP sites and agricultural sediments was not as high, and emergence and midge survival. This is likely attributable to the mode of action of the pesticides present at agricultural sites, that affect survival more than the non-specific toxicity of compounds at the urban sites. Employing bioassays allowed ranking of sediments based on biological responses rather than on the presence of target compounds. All contaminated sediments caused effects on the relatively resilient C. riparius. The phenomenon of underestimation of sediment contamination is presently understood. It is therefore concluded that ecotoxicological sediment quality assessment needs to be included in the EU WFD.

WE189
Quantifying the Bioavailability of HOCs associated with Suspended Sediment to Daphnia magna
X. Xu, X. Zhang, School of Environment, Beijing Normal University
In natural rivers, hydrophobic organic compounds (HOCs) are mainly associated with particulates, especially for the rivers with high suspended sediment (SPS) concentrations. Suspended sediment will affect the bioavailability of HOCs in rivers. However, research has been carried out to quantify the bioavailability of fraction of HOCs sorbed on different compositions of SPS with various particle sizes. In this study, we chose pyrene as a typical HOC to study the bioavailability of HOCs associated with SPS of various compositions and grain sizes to D. magna. The passive dosing devices were made to control the freely dissolved concentration of pyrene in the exposure systems. The effect of pyrene associated with SPS of different compositions (including amorphous organic carbon, AOC; black carbon, BC, and minerals) and grain sizes (including 0–50 μm, 50–100 μm, and 100–150 μm) on the immobilization and enzymatic activity of D. magna was investigated to quantify the bioavailability of SPS-associated pyrene. The results showed that with C_{sox} of pyrene ranging from 20.0–60.0 μg L^{-1}, the immobilization of Daphnia magna in the presence of 1 g L^{-1} SPS were 1.11–2.89 times that in the absence of SPS. The composition (AOC, BC, and minerals) and size of SPS were 1.11–1.70, 1.11–2.89, and 1.11–6.39 times that with 0–50 μm SPS, respectively. The bioavailability of fraction of pyrene sorbed on the three components of SPS was ordered as 50–100 μm > 0–50 μm > 100–150 μm. When pyrene C_{sox} was 20.0 μg L^{-1}, the immobilization caused by pyrene associated with different grain size SPS was ordered as 50–100 μm > 0–50 μm > 100–150 μm. When pyrene C_{sox} was 20.0 μg L^{-1}, the immobilization caused by pyrene associated with 50–100 μm SPS was 1.42 and 2.43 times that with 0–50 μm and 100–150 μm SPS, respectively. The protein and enzymatic activities of Daphnia magna also varied with different SPS and pyrene C_{sox}. The effect of SPS on the bioavailability of SPS-associated pyrene was mainly due to the difference in SPS ingestion by Daphnia magna and SPS composition, especially the organic carbon type, among the three sizes. According to the results obtained in this study, a model has been developed to calculate the bioavailability of HOCs to aquatic organisms in natural waters considering both SPS grain size and composition.

WE181
Sediment quality assessment in the Netherlands: Link between chemical, toxicological and ecological parameters
L. Lautz, Radboud University Nijmegen / Department of Environmental Science; J. Chai, Radboud University Nijmegen; R. Hoondert, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science; R. Van Zelm, Radboud University / Department of Environmental Science; J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science
Sediment quality assessment is often based on chemical analysis only, occasionally including toxicological assays. Full sediment quality assessment, including chemical and macrofauna analysis and toxicological assays, is not the standard procedure due to high costs. Based on chemical analysis only, it is not always clear whether sediment management in form of dredging and landfill or remediation is necessary. To reduce costs of sediment management on the one hand and to increase environmental benefits on the other, the right priorities need to be set. To do so, a joint research project between University of Lorraine / Laboratoire Interdisciplinaire des Ecosystèmes et Macrofaunes and macrofauna analyses. Chemical, toxicological and ecological data is available from freshwater/sediment monitoring campaigns in the Netherlands. A multivariate analysis was performed to identify contaminants with high impacts on the bioassays. From the 49 chemicals included in the dataset, 28 were significantly related to the outcome of bioassays of Daphnia magna and Chironomus riparius. The Species Sensitivity Distribution (SSDs) method was used to quantify the ecological risk associated with concentrations of contaminants. Based on the SSDs the potentially affected fraction (PAF) of species was calculated. These PAFs were used to calculate the multiple substances PAF, combining effects posed by multiple compounds. Such correlation analysis have not been conducted previously for a large dataset of field-collected sediments in the Netherlands. With our work we contribute to the quantification of relationships between chemical concentrations and toxicological assay in sediments. These relationships can be used in future analyses of predictive abilities of sediment quality and can be applied in an assessment tool for sediment management to determine management strategies.

WE182
Integrative approach to assess ecological risks of sediment metallic contamination in Lake Ohrid (Albania)
L. Minguez, LIEC (CNRS UMR 7360, Université de Lorraine) / Laboratoire Interdisciplinaire des Environnements Continentaux, CNRS UMR 7360; E.M. Giamberini, Université de Lorraine / LIEC, CNRS UMR 7360; S. Pain-Devin, Université de Lorraine - UL / LIEC - CNRS - UMR 7360; S. Devin, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; F. Guérard, Université de Lorraine - UL / Laboratoire interdisciplinaire des environnements continentaux LIEC CNRS UMR 7360; L. Giamberini, Université de Lorraine; CNRS UMR 7360 - LIEC, CNRS
It is now widely admitted that chemical monitoring of pollutants in waters and sediments is not sufficient to assess the risks caused by such pollution in aquatic ecosystems, since chemical data alone provide no indication of biological effects. Biological responses of exposed organisms need to be taken into account, allowing to define the ecotoxicological status of the studied system. The ancient lake Ohrid, the second largest lake in the Mediterranean basin, was chosen as case study. The Albanian side, due to the presence of ultramafic rocks, was a large mining area exploited to produce nickel, chromium, and iron until the early nineties. Several ore dumps from this past activity still remain near the shoreline, representing one potential input source of these metals. Several creeks flowing across soils naturally rich in metals also contribute to metal inputs into the lake. We studied three sites along the Albanian shoreline of Lake Ohrid, and defined by different metal pressures: “Pog” in an urbanized area but considered as dimly contaminated by metals, “Mem” and “Poj” located in the ultramafic area of the lake, at the vicinity of a Fe-Ni dump site for “Mem”, or nearby the outlet of a creek for “Poj”. In the two sites under metallic pressure, sediments contained high levels of metals with concentrations reaching 93.8 mg/kg for Co, 345.1 mg/kg for Ni, 43.0 mg/kg for Cr, 553.8 mg/kg for Ni, 49.9 g/kg for Fe and 872.9 mg/kg for Mn. Despite these high concentrations, metals are not necessarily bioavailable. This is why it is also important to combine chemical characterization (total and available pools) with the study of lethal and sublethal effects after acute and chronic exposure. In our study, we assessed ecological risks in Lake Ohrid using an integrative approach consisting in: (1) chemical and physical characterizations of sediments, (2) assessment of metal bioavailability, (3) ecotoxicological bioassays, and (4) the study of sub-lethal effects on organisms. During this presentation, the main results from this integrative work at Lake Ohrid will be presented.

WE183
Active Biomonitoring and DGT Passive Sampling: Holistic Assessment of metal bioavailability in sediments and associated risks
K. De Schampaert, Universiteit Antwerpen / Department of Biology (SPHERE and ECOBE Research Groups); H. Hetjens, University of Antwerp / Department of Biology (SPHERE Research Group); J. Touches, E. Amato, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group); P. Meire, University of Antwerp / Department of Biology (SPHERE Research Group); R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group)
Impacts of sediment metal contamination on aquatic ecosystems and their functioning remain a widespread problem. The ecotoxicological risk associated with metal contamination is dependent on metal speciation, sediment characteristics and the behavior and physiology of the affected organisms. Hence, bioavailable concentrations, rather than total metal concentrations, are often a critical factor in sediment risk assessment. Determination of bioaccumulation in organisms is a frequently used indicator for bioavailability. However, active and passive biomonitoring techniques are often time consuming and highly dependent

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on the exposed organisms, limiting comparability and standardization. Diffusive gradient in thin films (DGT) passive sampling is an innovative technique, allowing for the time-integrated measurement of potentially bioavailable metals in sediments or surface water. Divalent metals are selectively accumulated onto a Chelex-embedded hydrogel layer, providing a measurement of labile and weakly-bound metals. To evaluate DGT passive sampling measurements as a potential indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flanders (Belgium), in order to tag a freshwater and 3 brackish aquatic systems. Bioavailability of metals will be assessed by active biomonitoring through a 4 weeks exposure of caged macroinvertebrates, after which bioaccumulation will be determined. The organisms will be exposed both at the sediment water interface and in the water column. A pilot study, carried out in November 2017, 3 bivalves and a polychaete worm are exposed in the Zenne river (north of Brussels) to test for their active biomonitoring applicability. During the 4 weeks exposure period, DGT passive samplers will be deployed 3 times for a period of 24h at the sediment water interface and in the water column. Relationships will be determined between the bioaccumulation in the exposed organisms and the determined DGT fluxes. Bioaccumulation and passive sampling measurements as the sediment water interface and in the column will be evaluated. The experiment aims at establishing relationships between bioaccumulation in different macroinvertebrate species and passive sampling measurements, and further validating the DGT passive sampling technique as a monitoring tool for sediment quality assessments in both freshwater and brackish aquatic systems.

WE184 Bioturbation in contaminated sediments: effects on exposure, toxicity and biogeochemistry.

T.M. Remulla, W. Bennett, Griffith University / Environmental Futures Research Institute; S.L. Simpson, Centre for Environment; D.O. Land and Water / Centre for Environmental Contaminants Research; R.A. Turner, University of Antwerp / Department of Biology; D.T. Welsh, Griffith University / Environmental Futures Research Institute; E. Lombi, University of South Australia / Future Industries Institute; D. Howard, Australian Synchrotron; D.F. Jolley, University of Wollongong / School of Chemistry.

Sediments are a major sink for a range of contaminants. Organism-sediment interactions such as bioturbation can alter sediment physicochemistry, and facilitate the diffusion of reactive chemical species (e.g. O3) into deeper sediments, potentially changing the oxidation state of various redox-sensitive materials and the fate and toxicity of contaminants. We applied multidisciplinary to: (i) characterise influences of bioturbation on contaminant fate, exposure and toxicity to aid current sediment quality guidelines and passive sampling measurements as the sediment water interface and in the water column; (ii) determine the potential of DGT to monitor bioturbation in the management and natural recovery of heavily degraded sediment ecosystems. Increased bioturbation in predominantly metal-contaminated sediments increased bivalve (Tellina deltoidalis) and amphipod (Victoriopsia australiensis) survival from 53 to 100% and 42 to 93%, respectively; and reproduction in a second amphipod (Melita plumulosa) from 3 to 65%. This was attributed to the decreased concentrations of dissolved copper in the overlying water associated with bioturbation. Conversely, increased bioturbation in sediments contaminated by metals and hydrocarbons decreased reproduction (44 to 23%), which was attributed to an increased release of polycyclic aromatic hydrocarbons (PAHs). High-resolution chemical imaging dissolved oxygen and metals in a legacy contaminated sediment mesocosm with a bioturbator present showed the interconnection of oxygen through sedimentary layers water and the impact organism-induced fluxes of nickel and zinc into burrow and overlying waters. The presence of nickel and zinc in burrow and overlying waters demonstrated that organism exposure is likely to be greater from the burrow waters than from the pore waters. This is consistent with increased accumulation of zinc observed with co-habitation of bivalves and amphipods. Low copper and lead concentrations in burrow waters during bioturbation events was consistent with the results of previous tests, where copper concentrations were lower in the presence of high bioturbation intensities, possibly due to binding with iron-(oxy)hydroxide phases or to resuspended particulate phases. These results highlight the importance of considering organism-interactions during sediment quality assessments, and the contributions they have to biogeochemistry and contaminant exposure to surrounding ecosystems.

WE185 The diffusive gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod

M. Gillimore, Centre for Environment; G.A. Price, University of Wollongong / School of Chemistry; L.A. Golding, CSIRO Land and Water; J. Stauber, CSIRO / CSIRO Land and Water; M.S. Adams, CSIRO, S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; D.F. Jolley, University of Wollongong / School of Chemistry.

Mining of lateritic nickel ore deposits within the Southeast Asia and Melanesia region is expected to intensify as sulphide nickel ore deposits become depleted. The close proximity of these mining operations to coastal ecosystems places marine benthic organisms at a potential risk of adverse effects related to nickel exposure. Currently, limited data exists for the effects of sediment nickel exposure on coastal marine organisms. The diffusive gradients in thin films (DGT) technique has emerged as a tool that allows for the rapid in situ measurement of the lability and dynamics of metals in sediment. The objective of this research was to determine effects thresholds for sediment-nickel by measuring reproduction of the estuarine-marine amphipod, Melita plumulosa in 10-d whole-sediment bioassays with three nickel-spiked sediments and two field-collected nickel-contaminated sediments with varying chemical and physical properties. We compared concentration-response relationships for both traditional method of fractionation of metals from sediments with DGT-labile nickel to determine whether DGT can be used to predict nickel bioavailability and toxicity. Effect concentrations of total recoverable nickel (TR-Ni) to cause a 50% impairment in reproduction (EC50) were 2000 (1200-2900), 1100 (580-1700) and 1100 (740-1500) mg/kg for the silty, sandy-silt and sandy sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (2000 mg/kg TR-Ni) and Site 2 (1300 mg/kg TR-Ni) had reproductive responses of 88% (±10) and 71% (±11) of the control, respectively. The EC50s based on DGT-labile Ni were 2.3 (1.7-3.4), 3.3 (1.7-9.4) and 2.0 (1.0-3.0) mg/m²h for silty, sandy-silt and sandy sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (0.4 mg/m²h DGT-labile Ni) and Site 2 (1.0 mg/m²h DGT-labile Ni) sediments, respective reproductive responses were 88% (±10) and 71% (±11) of the control. This demonstrates that amphipods were responding to the labile nickel as measured by DGT and further supports its use in nickel risk assessments.

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA

J. Yang, H. Li, F. Cheng, Jinan University / School of Environmental Science; T. Li, University of South Australia / Future Industries Institute; D. Hou, Griffith University / Centre for Environmental Contaminants Research; L. He, Griffith University / Microbial ecology of anthropised river systems; L. De Villeurbanne, École Polytechnique Fédérale de Lausanne / Microbial ecology of anthropised river systems; L. Alencastro, École Polytechnique Fédérale de Lausanne / Central Environmental Laboratory.

In Guangzhou, China using a integrated method of TIE and EDA was found to be a poor predictor of toxicity for the two field nickel-contaminated sediments. Site 1 (2000 mg/kg TR-Ni) and Site 2 (1300 mg/kg TR-Ni) had reproductive responses of 88% (±10) and 71% (±11) of the control, respectively. The EC50s based on DGT-labile Ni were 2.3 (1.7-3.4), 3.3 (1.7-9.4) and 2.0 (1.0-3.0) mg/m²h for silty, sandy-silt and sandy sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (0.4 mg/m²h DGT-labile Ni) and Site 2 (1.0 mg/m²h DGT-labile Ni) sediments, respective reproductive responses were 88% (±10) and 71% (±11) of the control. This demonstrates that amphipods were responding to the labile nickel as measured by DGT and further supports its use in nickel risk assessments.
To do this, a sampling grid composed of 15 sites was developed in the discharge area of the effluent from the Flon river into the lake. At each point, sediment samples were collected to measure metal concentrations and assess the ecotoxicological quality of sediments in the laboratory using a whole sediment toxicity test with ostracods. At six selected sites in the central transect of this sampling grid, corresponding to the extension of the outlet of the Flon river, a more detailed monitoring program was applied, with measurements of PCBs and PAHs concentrations by high-resolution gas chromatography, the chemistry of sediment samples from the catchment area of the North Sea region with management problems related to polluted sediments. The locations of the sites are in the Port of Hamburg and along the River Elbe in Germany, on the Rivers Hull in the UK and Scheldt in Belgium and in the Netherlands. The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, eluates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system.

References
mortalities as predicted by models and the scientific literature. Physiological parameters investigated in rainbow trout acted as early signals of biological defects pointing out a high level of genotoxicity measured in erythrocytes in exposed individuals as well as in the control batch; these decreased during the experiment until a basal level pointing out the resilience of fish whereas they were exposed for 28 days to high fine sediment concentrations. Roshu exposure to suspended fine sediments did not induce genotoxicity or an oxidative stress response. These results meant that fine sediment exposure did not lead to a physiological stress through the alteration of respiration and osmoregulation homeostasis but suggested that trout experienced undesired past stressful conditions (aquaculture) independent from the sediment exposure. However, we cannot conclude that exposures of juvenile fish to such sediment concentrations would not lead to biological detrimental effects without further considering environmental sediment quality.

WE192 Assessing the bioavailability of metals in natural sediments by DGT passive sampling and bioaccumulation
H. Hetjens, SHERE / SPHERE; K. de Schamphelaere, University of Antwerp; Department of Biology SPHERE and ECORE Research Groups; I. Tuchies, E. Amato, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Worldwide, high metal concentrations from recent and historic sediment contamination form a widespread problem and are of major concern for water system management due to their impact on the surrounding water quality and resident biota. Sediment (bound) metals can be present in various forms of physicochemical, toxic, and ecological levels. A major concern is the fact that these substances are not fully removed during common wastewater treatment processes or by nature and therefore cannot be discarded as harmless waste. The results of this study showed that fine sediment exposure did not lead to a physiological stress through the alteration of respiration and osmoregulation homeostasis but suggested that trout experienced undesired past stressful conditions (aquaculture) independent from the sediment exposure. However, we cannot conclude that exposures of juvenile fish to such sediment concentrations would not lead to biological detrimental effects without further considering environmental sediment quality.

WE193 Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment
N. Wilbrand, RWTW Aachen University; A. Shuliakievich, Institute for Environmental Research (RWTW Aachen University) / Institute for Environmental Research; Y. Müllner, RWTW Aachen University / Institute for Environmental Research; S. Schiwy, RWTW Aachen University / Department of Ecosystem Analysis; H. Hollert, RWTW Aachen University / Institute for Environmental Research

Since our economic progress continues, the environmental pollution increases. The contamination of the aquatic environment with chemicals is one of the major concerns of our environment. Microplastics have been identified in environmental samples, including sediments and aqueous phases, and have been linked to various human health risks. This study aimed to examine the ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant (WWTP) - state of a receiving river before implementing an ozonation treatment. The main objective of this study is to further evaluate the use of DGT passive samplers as indicators for the bioavailability of metals for (benthic) macroinvertebrates and to test the robustness of the results from laboratory studies under field conditions. In an extensive field and laboratory study, which will be performed in April 2018, the impact of a range of contaminated natural freshwater sediments with known physicochemical characteristics and metal gradients on species performance will be tested. Bioavailable metal fractions will be determined by the use of DGTs and by measuring the metal body burden and metal concentrations in the surrounding seawater. The results of this study are expected to increase the insights in the applicability of passive samplers for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

WE194 Dredging sediment quality evaluation: a comparison of an ecotoxicological classification using an weight-of-evidence approach and a “pass to fail” criteria
V. Piazza, E. Costa, F. Garaventa, CNR ISMAR; D. Sarti, V. Vitiello, D. Pellegrini, ISPIRA Institute for Environmental Protection and Research; I. Lanzoni, Department of Life and Environmental Sciences Polytechnic University of Marche Ancona Italy; F. Regoli, Università Politecnica delle Marche; M. Faimali, CNR ISMAR

Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decreto of Italian Ministry of Environment n. 173/2016), establishing criteria and methodological procedures for dredging sediment characterization, their classification and identification of appropriate management options and monitoring. One of main novelties is represented by the Enviro rule allowed by ecotoxicology, H. Bouquet, E. G. Wagening. A battery of bioassays that considers the use of three species belonging to different trophic levels has to be applied both to whole phase and liquid phase (pore water or elutriate) of sediment. The results of ecotoxicological analyses are then assessed as a whole at the level of “battery” (not of single bioassay). Weighting the biological relevance of the measured effects, the sensitivity of organism, the statistical significance of measured results and the actual sediment conditions in the environment formation of exposure. Chemical and ecotoxicological data are finally integrated for sediment quality assessment, following the weight of evidence (WOE) criteria, this representing an innovative approach respect to previous regulation, where chemical classification was determined by at least one parameter exceeding the threshold level and ecotoxicological classification was determined by the lowest bioassay result of the whole battery. In this work, a comparison between “old” and “new” sediment quality assessment was performed, applying the two classification methods to ecotoxicological data obtained on dredging sediments from different study sites. Results obtained underline the importance of using an integrated and weighted approach (WOE) respect to a “pass to fail” criteria.

WE195 Toxicity of sediment-bound lufenuron to aquatic arthropods in laboratory bioassays
T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environmental Risk Assessment Team; D. Boerwinkel, Wageningen Environmental Research / Environmental Risk Assessment Team; M. Kraak, University of Amsterdam / IBED-FAME; J. Vonk, University of Amsterdam / IBED-FAME; I. Roessink, Alterra / Environmental Risk Assessment

Lipophytic pesticides are frequently detected in sediments, potentially leading to toxic effects on benthic organisms. Currently, prospective sediment risk assessments for pesticides are mainly based on results of laboratory bioassays with a few standard test species (Chironomus sp. and Hyalella azteca). It is, however, uncertain whether these standard benthic test species are representative for a wider array of freshwater benthic organisms. We selected the benzoylurea insecticide lufenuron as one of the benchmark substances to evaluate the prospective environmental risk assessment procedure for sediment-associated pesticides. 10-day and 28-day toxicity estimates from sediment-spiked laboratory bioassays with benthic arthropods belonging to different taxonomic groups are presented. In the 10-day sediment-spiked toxicity tests the LC50 values showed the following order from low to high LC50: Caenis horaria > Chironomus riparius > Gammarus pulex > Chironomus dilutus > Hyalella azteca > Asellus aquaticus and Sialis lutaria. The Hazard Quotient Concentration to 5% of the tested species (HC5 and 95% confidence limit) derived from these 10-d LC50 values was 2.2 (1.5-2.7) µg/g organic carbon (OC). This HC5 value is approximately a factor of 2 lower than the 10-d LC50 estimate (3.47 (3.27) µg/g OC) for the most sensitive standard test species Chironomus riparius. Valid 28-d LC10 values could be derived for 7 benthic arthropods. These 28-d LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Caenis horaria > Ephemera danica > Hyalella azteca > Gammarus pulex > Sialis lutaria. The HC5 and 95 confidence interval derived from these 28-d LC10 values was 0.13 (0.02-1.59) µg/g OC. This HC5 value is approximately a factor of 3 lower that the 28-d LC10 estimate for the most sensitive standard test species Chironomus riparius (0.49 (9.47) µg/g OC). These data show that Chironomus riparius is a representative standard test species to assess the potential risks of sediment exposure to the insecticide lufenuron. The HC5 obtained from 28-LC10 values was a factor of 6 lower than the the NOEC for the most sensitive
population (0.79 µg/g OC) in a sediment-spiked microcosm experiment, while the HCs from 10x-L500’s was approximately a factor of 3 higher than this microcosm threshold concentration.


**WE198** Global overview of aquaculture production with a focus on the development and current status of the activity in Portugal C.V. Rocha, MARE-FCUL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University Aquaculture activity experienced true global development firstly at the beginning of the 1990’s and then around 1970’s, as a result of the awareness of the negative impacts that years of intensive fisheries brought to wild stocks’ status, which contributed to the assessment of the effective exposure for the predominantly surface sediment dwelling test organism. Therefore, we developed an undisturbed sampling technique and processing enabling the depth-related analysis of active substances in pore-water and adsorbed to sediment particles. After removing the water phase, plastic tubes were stung into the ca. 15 mm-thick sediment layer, which was subsequently frozen by liquid nitrogen. By the use of a special developed cutting device, the sediment cores were cut into three slices providing a thickness of ca. 5 mm. Each sediment slice was centrifuged to isolate the pore-water. A sequential extraction was performed to extract the sediment adsorbed residues. After combining the sediment extracts, pore-waters and sediment extracts were analysed by LC-MS/MS. To validate this newly developed sampling technique, a Chironomid toxicity study acc. to OECD TG 219 was conducted. Two model compounds (logKow<1) and 1 B (logKOW<2) were applied as mixture at nominal concentrations of 2 µg/L. To investigate the spatiotemporal behaviour of the compounds, test systems were incubated and processed 3, 7, 14, 21, and 28 days after treatment (DAT). The concentration of the applied compounds decreased in the overlying water during the experimental duration. Both compounds were primarily found adsorbed on the sediment phase (ca. 40-50 % of applied compounds). Approx. 0.2 - 1 % of the applied compounds were recovered in the pore-water at the same time. The analytical results of pore-water and sediment extracts show that the highest amounts of both compounds were in the upper layer of the sediment during the experimental duration. Nevertheless, the results indicate the concentrations differences between the top layer and the layers below will be equalized in the course of time. These first results indicate that the newly developed sampling technique can provide a substantial contribution to a more realistic determination of exposure concentrations in chronic water-sediment toxicity tests, leading to an improved sediment risk assessment.

**WE197** SETAC Sediment Interest Group P.K. Sibley, University of Guelph / School of Environmental Sciences Improving the environmental risk assessment of the aquaculture 'Blue Revolution' (P)

**WE200** Effects of antibiotic residues on the composition and diversity of a microcosm aquatic microbial community. B. García Bueno, I. Gomez, J. Martinez, C. Marin, B. Martinez-Lopez, A. Marin, University of Murcia / Ecology and Hydrology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology Initial aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics may cause adverse effects on potentially sensitive organisms such as non-target microorganisms, primary producers or benthic invertebrates. The objective of this study was to evaluate the potential side effects of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the community composition of marine biofilms exposed to these substances and on the surrounding seawater. Marine biofilms were exposed to oxytetracycline and flumequine for one week under laboratory conditions. Subsequently, the exposed biofilms were used to feed G. aequicauda aquaria for two weeks. The G. aequicauda aquaria set up was run with two treatments in parallel: (1) with input of antibiotics only from the biofilm and (2) with antibiotics administered via biofilm and also spiked into the water. This was done to test different bioaccumulation routes (i.e., ingestion only and water exposure combined with ingestion). All the treatments for biofilm and crustaceans test were run in triplicate. Preliminary results show a marginally enhanced biomass growth of the biofilm with increasing dose of both antibiotics,
being this slightly higher in the oxytetracycline test. No correlation was found between antibiotics concentration and elemental composition (analyzed carbon, sulfur and total phosphorous), although nitrogen content was slightly higher in the medicated biofilm. Biofilm arborescence (vertical structures observed through optical microscopy) coverage was statistically different among treatments, showing a non-linear response. Experimental results show that low exposure concentrations contributed to a high arborescence up to 100 µg/L, while the highest tested concentrations contributed to a decrease of the biofilm structure. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial generic characterization (microbiome and resistome), diatoms identification, and photosynthetic activity assessment. Regarding the G. aequicada test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

WE201
Shifts in the diatom assemblage structure and biological traits of marine biofilms exposed to antibiotics in aquaculture
N. García Bueno, C. Marin, A. Marin, University of Murcia / Ecology and Hydrology; B. González-Gaya, IMDEA Water (G84912732) / Environmental Chemistry; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

The use of antibiotics, anti-fouling paints, and fish food are all potential sources of chemical contaminants from commercial aquaculture operations such as fish farms. In the present study, the effects of H2O2 and antibiotics in the order Mycophenolate (MPA) and the quinolones Ciprofloxacin (C) and Levofoxacin (LV) were studied. The selection of these substances was based on the treatment of which requires the intensive use of antibiotics. The objective of this study was to evaluate the potential side effect of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the diatom assemblage structure and biological traits of marine biofilms exposed to these substances. Biofilms were grown during two weeks under natural conditions on glass slides. Then two experiments were conducted in the laboratory. For the first experiment, field-grown marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of each single antibiotic compound for one week and then changes on chemical and biological composition were analyzed. In the second experiment, biofilms exposed to the same antibiotic concentration range were transported to field conditions after two weeks of exposure in order to evaluate their recovery capacity. In both experiments, diatoms were determined to the lowest possible taxonomic level under the microscope (Nikon Eclipse TE2000-U). The taxonomic abundance of the sampled quadrants of each replicate was averaged and referred to the area sampled to obtain the taxon density per replicate. The fine structure of diatoms was analyzed under a scanning electron microscope (JEOL-6100). The diatom composition, the relative abundance of species (%), the Shannon-Wiener diversity index (H′) and species richness were calculated for each sample and then summarized per treatment. The growth forms (biological traits) of species were analyzed before detachment and were grouped according to the literature. The biofilms were dominated by a reduced number of taxa, including the diatoms Brachysira aponica and Coccosoira placentula. High exposure concentrations of oxytetracycline and flumequine (100 and 1000 µg/L) resulted in the dominance of the general diestes, Hyalosphenia and Licmophora. The global architecture and traits of the biofilms were also influenced by the high antibiotic exposure concentrations.

WE202
Assessing the oxidizing effects of hydrogen peroxide using flow cytometry as a high throughput method
A. Almeida, Norwegian Institute for Water Research NIVA; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment

Hydrogen peroxide (H2O2) is widely used in commercial, industrial, medical, environmental and hygiene applications. It is applied in aquaculture for controlling biological problems such as salmon lice. H2O2 produces highly oxidizing radicals that can cause paralyse, peroxidation in organelle membranes and inhibition of enzymes that replicate DNA in biological organisms. The release of H2O2 as an effluent into the marine environment is therefore a cause for concern particularly to primary producers such as algae. With the use of flow cytometry, single cells of algae with different features and physiological states, can be examined based on the quantification of species (%), the Shannon-Wiener diversity index (H′) and species richness were calculated for each sample and then summarized per treatment. The growth forms (biological traits) of species were analyzed before detachment and were grouped according to the literature. The biofilms were dominated by a reduced number of taxa, including the diatoms Brachysira aponica and Coccosoira placentula. High exposure concentrations of oxytetracycline and flumequine (100 and 1000 µg/L) resulted in the dominance of the general diestes, Hyalosphenia and Licmophora. The global architecture and traits of the biofilms were also influenced by the high antibiotic exposure concentrations.

WE203
An updated version of the SEPA BathAuto tool for assessing anti-parasitic chemical treatments in marine fish farms
J. Cannall, Cambridge Environmental Assessments; A. Berkeley, Scottish Environment Protection Agency; F. Ericher, CEA; G. Hughes, Cambridge Environmental Assessments

Marine fish farms operators in Scotland wishing to use anti-parasitic chemicals as bath treatments must first obtain a discharge licence from the Scottish Environment Protection Agency (SEPA). Discharge licences are granted by SEPA on a per-site basis, with the quantity of chemical that can be released from a particular fish farm determined by computer modelling. This computer modelling considers the location and composition of the fish farm, along with hydrographic data measured at the site and the toxicology and environmental fate of the chemicals concerned. Discharge quantities are typically calculated for three anti-parasitic chemicals: azamethiphos, cypermethrin and deltamethrin. Of these, cypermethrin and deltamethrin are rapidly removed from the aqueous phase via binding to particles, and are therefore assessed using SEPA’s short-term model, which calculates projected concentrations in the chemical patch up to 6 hours after its release from the fish farm. Azamethiphos, however, remains in the aqueous phase for several days until it is broken down, and is therefore also assessed using a longer-term model, originally developed by Gillibrand and Turrell (1999; MLA Report No 299) and recently extended by Cannall, Ericher and Hughes (2017; poster presentation at SETAC Europe 2017). The SEPA tool BathAuto integrates both the short and long-term models, iteratively performing calculations of chemical concentrations in the water in order to arrive at safe discharge limits for a fish farm. In this poster we present an updated version of BathAuto in which the longer-term model is now fully integrated into the BathAuto tool. The standalone executable required previously for the long-term calculations (opendisp.exe) is no longer used, improving the compatibility of the revised tool with modern operating systems. While the standard modelling parameters required by SEPA for discharge licensing in Scotland are included as default, BathAuto could readily be modified to include alternative parameters or chemical data, potentially making this tool available for use by other jurisdictions. The revised version of BathAuto also offers improved graphical outputs, and the ability to calculate several options for compliant cage treatment regimes.

WE204
State-of-the-art on the use of models for the ERA of chemicals used in aquaculture
A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; T.P. Teixeira, Aquatic Ecology and Water Quality Management Group b Alterra; M. ter Horst, Alterra, WUR / Environmental Risk Assessment Team; M. Tsapakis, Hellenic Centre for Marine Science / Institute of Oceanography; I. Kalantzi, Hellenic Centre for Marine Research / Institute of Oceanography; R. Torres, Plymouth Marine Laboratory; N. García Bueno, A. Marin, University of Murcia / Ecology and Hydrology; L. Falconer, Institute of Aquaculture; T.C. Telfer, University of Stirling

Aquaculture is expanding and becoming a more diverse industry in terms of species and production systems, there is an increasing demand to generate improved modelling tools to assess its environmental impacts. Although important developments have been made in disease prevention and treatment, the use of veterinary medicines and other potentially toxic substances (e.g. antifoulants, metals) is still prevalent. Such use has led to concern for the potential ecological risks of veterinary medicines applied in aquaculture production. This study presents an overview on the use veterinary medicines and other potentially toxic substances used in EU aquaculture, and the environmental standards and regulatory procedures available for their Ecological Risk Assessment (ERA). Furthermore, it describes the state-of-the-art on the development of models capable of assessing the fate, dispersal, exposure, ecological effects and associated ecological risks of veterinary medicines applied in aquaculture production. This study shows that a varied range of models has been developed during the last 30 years. Their effective implementation in regulatory ERA is, however, somewhat limited in many state members. Some recommendations are provided as to improve the chemical exposure assessments and the ecological realism of the modelling outcomes, paying a special attention to the protection goals set for the regulatory ERA of veterinary medicines.

WE205
Effects of an aquaculture parasiticide (diflubenzuron) on non-target shrimp
populations: from lab experiments to population-level endpoints
J. Mog, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; D. Hjermann, NIVA Norwegian Institute for Water Research; E. Ravagnan, R. Bechmann, International Research Institute of Stavanger
The continued growth of marine aquaculture production has presented the industry with environmental and production concerns, of which the ecotoxicological significance of benzobicyclon (Benzobicyclon) is a major concern. Benzobicyclon is the active ingredient in the herbicide, BUTTE®, and is approved for use in the United States and California as of 2001. Various studies have demonstrated that shrimp exposed to DFB through water treatment reduce survival by 60% compared to control, in both the larval and adult stages. Moreover, the effects of DFB exposure are more severe under future climate conditions (higher temperature). The aim of this study is to make the information on these mechanistic effects more relevant for risk assessment at the population level. We have developed an age-structured population model representing a Northern shrimp population located in a hypothetical Norwegian fjord containing a fish farm, under both ambient and future climates. Our model is based on thorough knowledge of shrimp biology and clear results on toxicological effects from the laboratory experiments. Nevertheless, extrapolating the individual-level effects to the population level poses several challenges. Relevant information on shrimp populations in fjords is sparse (such as abundances, survival and reproductive rates, and their daily consumption). The degree of exposure to pesticide residues at different distances from aquaculture farms is also uncertain. We have therefore developed a set model scenarios representing different medicine application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DFB exposure on population-level endpoints such as long-term abundance and age structure, and to assess the risk of population decline below threshold abundances.

WE206 Contamination and bioaccumulation of heavy metals in the wild and marine farmed milkfish (Chanos chanos) and mullet (Mugil cephalus) and associated health risk along the coasts of Tanzania
E-B. Mwakalanga, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; C.K. Simukoko, University of Dar es Salaam; J.L. Lyche, Norwegian University of Life Sciences; M.H. Müller, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; A.J. Mmochi, Institute of Marine Sciences University of Dar es Salaam; R.H. Mdegela, Sokoine University of Agriculture; C.K. Simukoko, University of Zambia; J.L. Lyche, E.B. Mwakalapa
We have developed an age-structured population model representing a Northern shrimp population located in a hypothetical Norwegian fjord containing a fish farm, under both ambient and future climates. Our model is based on thorough knowledge of shrimp biology and clear results on toxicological effects from the laboratory experiments. Nevertheless, extrapolating the individual-level effects to the population level poses several challenges. Relevant information on shrimp populations in fjords is sparse (such as abundances, survival and reproductive rates, and their daily consumption). The degree of exposure to pesticide residues at different distances from aquaculture farms is also uncertain. We have therefore developed a set model scenarios representing different medicine application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DFB exposure on population-level endpoints such as long-term abundance and age structure, and to assess the risk of population decline below threshold abundances.

WE207 Potential Toxic and Phototoxic Effects of Benzo[c]yclopyrrole on Crayfish
E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; L.M. Basirico, Louisiana State University; W. Xu, C.G. Lutz, Louisiana State University AgCenter / Renewable Natural Resources; K. Armbrecht, Louisiana State University / Environmental Sciences School of the Coast and Environment
Benzo[c]yclopyrrole is the active ingredient in the herbicide, BUTTE®. In 2001, various formulations using benzo[c]yclopyrrole as the active ingredient were approved for use in Japan. It was approved for use in the United States and registered in California as of 2016, and was first applied to rice fields in the 2017 growing season. Benzo[c]yclopyrrole is a herbicide that acts as a HPPD inhibitor, leading to the bleaching of weed species to ultimately kill them. With an increase in herbicide-resistant weed species, new formulations of herbicides to combat this in rice fields is advantageous. California is the second largest producer of rice in the United States, with Louisiana as the third largest producer; Arkansas leads the country in rice production. Unlike California, Louisiana has a unique system where rice fields not only grow rice but also grow crayfish for harvest and consumption. The bleached rice fields are prime habitat for crayfish to reside; therefore, crayfish are at risk for exposure to pesticides used in the rice production. Benzobicyclon readily hydrolyzes to benzobicyclon hydrolyslate, and therefore it likely undergoes photolysis as well. The potential for toxic or phototoxic impacts of benzobicyclon or its intermediate degradation products to crayfish is important to know for the possible future registration of BUTTE® in Louisiana.

WE208 Effects of the isoflavones, genistein and daidzein, on Acetylcholinesterase from head of Solea senegalensis.
G. Al bendin, Universidad de Cádiz (Spain) / Toxicology Area; V. Aranda, University of Cadiz / Toxicology Area; M. Manuel, University of Cadiz / Analytical Chemistry; J. Ortiz, C. Sarasquete, CSIC Spanish National Research Council; J. Arellano, University of Cadiz / Toxicology Area
The aquaculture is an important economic activity in our area, and one of the main concerns of this sector is fish feed. One of the proposed alternatives to fish meal in feeds are vegetable proteins, and among plant protein sources, soybean is noteworthy. This plant has flavonoids including the isoflavones daidzein and genistein. Solea senegalensis is a flatfish of high commercial importance both in aquaculture and fisheries in Southern Europe with a wide geographic distribution and availability, and its biological cycle is well known. The aim of this work was to study the effects of the isoflavones, genistein and daidzein, on juveniles (weight 1.23±0.41 g) of Solea senegalensis. The 96-h toxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19-20°C and a photoperiod of 12h light/12h dark. In a weight of 10 g/ml, daidzein (range 0.625-10 mg/l), plus an untreated control and a solvent control (DMSO). Mortality was recorded and fish head acetylcholinesterase (AChE) was measured with acetylthiocholine as a substrate after inhibiting butyrylcholinesterase with iso-OMP. No mortality was observed within the period of the test when the fishes were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head AChE activity was not altered in fish exposed to genistein, but daidzein was found to enhance AChE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Culture at University of Cádiz for providing the experimental fish used in this study, and this work was supported by National R&D&I Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDII group: RNM-345).

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)

WE209 Comparison between results of LumiMARA and Microtox Tests
M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; P. Baldoni-Andrey, C. GELBER, F. Monsède, TOTAL SA
In regulatory context of ever increasing environmental responsibility (OSPAR convention, BREF CWW), there is a need to have biomonitoring tools to evaluate waste water quality. To date, and for several decades, the standard toxicity testing tool used for rapid analysis of waste water has been Microtox®. However, recently a new tool has become available: LumiMARA®, an acute ecotoxicity bioassay which measures the influence of luminescence on bacteria in a similar way to Microtox®, its main disadvantages are that it is dark. Juveniles were exposed at five nominal concentrations of genistein (range 1.25-20 mg/l) and daidzein (range 0.625-10 mg/l), plus an untreated control and a solvent control (DMSO). Mortality was recorded and fish head acetylcholinesterase (AChE) was measured with acetylthiocholine as a substrate after inhibiting butyrylcholinesterase with iso-OMP. No mortality was observed within the period of the test when the fishes were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head AChE activity was not altered in fish exposed to genistein, but daidzein was found to enhance AChE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Culture at University of Cádiz for providing the experimental fish used in this study, and this work was supported by National R&D&I Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDII group: RNM-345).

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)
in a freshwater environment may be overestimating toxicity of effluents to the freshwater compartment.

WE210 Bioluminescent assays as tools for studying antioxidant activity and toxicity of bioactive compounds

A.S. Sachkova, Tomsk Polytechnic University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryasheva, Institute of Biophysics SB RAS

This study promotes application of the bacteria-based and enzyme-based bioluminescent assays to evaluate the antioxidant activity of bioactive compounds in oxidizers solutions. Artificial and natural carbon nanostructures – fullerene and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L respectively. The immobilized enzyme system was more vulnerable to C6H5F than its soluble form, with an IC50 equal to 1.4 mg/L. According to EC Directive 93/67/EEC for aquatic organisms, chemicals are classified by their degree of toxicity based on EC50 values. We hypothesised that this classification was correlated with IC50 values and revealed that MWCNT and SWCNT samples might be characterised as extremely toxic and very toxic, respectively. Due to its technical simplicity, rapid response time and high sensitivity, this bioluminescent method has the potential to be developed as a general enzyme inhibition-based assay for a wide variety of nanomaterials. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

WE211 Effect of low-dose gamma-radiation on luminous marine bacterium Photobacterium phosphoreum

A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agrotechnological Technologies; D.V. Dementyev, Institute of Biophysics SB RAS / Radiobiology Lab; N. Kudryasheva, Institute of Biophysics SB RAS

The study addresses biological effects of low-dose gamma-radiation. Radioactive 137Cs-containing particles were used as model sources of gamma-radiation. Luminous marine bacterium Photobacterium phosphoreum was used as a biosensor to test this bacteria's sensitivity to the low-dose gamma-radiation exposure (≤250 mGy). The inhibition efficiency was measured at 5, 10, and 20° for 175, 100, and 47 h, respectively, at different dose rates (up to 4100 mGy/h). There was no noticeable effect of gamma-radiation on the 20° results, while the 20° exposure revealed authentic bioluminescence inhibition. The 20° results of gamma-radiation exposure were compared to those for low-dose alpha- and beta-radiation exposures studied previously under comparable experimental conditions. In contrast to ionizing radiation of alpha and beta types, gamma-emission did not initiate bacterial bioluminescence activation (adaptive response). As with alpha- and beta-radiation, gamma-radiation did not demonstrate monotonous dose-effect dependencies, while irradiation with gamma-radiation decreased more than tenfold when there is a toxic effect on photosynthesis. This delayed fluorescence is registered in red spectrum area after exciting light flashes in the form of time-attenuated radiation. We found out that the ratio of DF excited by high intensity flashes to DF excited by low intensity flashes decreases more than tenfold when there is a toxic effect on photosynthesis. This indicator can be measured within a few seconds. Due to the relative nature of this indicator, which characterizes the photosynthetic activity of the plant test organism, it does not depend on the size or volume of analyzed sample. To implement this method, we developed the Photon 10 fluorimeter which automatically measures the relative indicator of delayed fluorescence (RIDF) in 24 plant samples. Simultaneously with RIDF, the device registers the variable part of prompt fluorescence of these samples. Applying this device we carried out transplanted lichen indication of air pollution in Krasnoyarsk. We found that the values of DF of several species of lichen differed up to 20 times between ecologically clean and industrial areas of the city after three weeks of the exposure. The study of the condition of pine needles in these areas showed a difference in the value of the RIDF up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorella vulgaris alga was used as a test organism. RIDF of Chlorella vulgaris suspension decreased by the factor of 2 (EC50 = 60 mg/L) in solutions of copper and zinc ions at a concentration of these heavy metals of 0.005 and 0.5 mg/dm³ respectively.

WE212 Bioluminescent Assay for Toxicological Assessment of Nanomaterials

E. Esimbekova, Institute of Biophysics SB RAS; E. Nemtsova, Siberian Federal University / Institute of Biophysics and Biotechnology; Y. Kratavsk, Siberian Federal University / Biophysical

Due to the increasing scale of production and usage of a vast number of new materials in industrial and economic activities, society is faced with problems associated with a lack of materials safety assessment regarding humans, ecosystems and the biosphere as a whole. Nowadays, numerous toxicological investigations using living organisms, cell lines, etc. are carried out laboratories in order to assess the potential risks of using these materials and their biological effects on human health and the environment. A rapid bioluminescent enzyme inhibition-based assay was applied to predict the potential toxicity of carbon nanomaterials (CMN) presented by single- and multi-walled nanotubes (SWCNT and MWCNT) and aqueous solutions of hydrazine fullerene (C60H2F). This assay specifically detected the influence of substances on parameters of the soluble and immobilised coupled enzyme system of luminous bacteria: NADP+/FMN-oxidoredutase + luciferase (Red + Luc). A protocol based on the optical properties of CMN for correcting the results of the bioluminescent assay was developed. If the toxicity of the nanomaterial solution was greater than 0.1 in the range of 400-600 nm, the light emission intensity was multiplied by the correction factors. It was shown that the inhibitory activity of CMN on Red + Luc decreased in the following order: MWCNT > SWCNT > C60H2F. The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L respectively. The immobilized enzyme system was more vulnerable to C60H2F than its soluble form, with an IC50 equal to 1.4 mg/L. According to EC Directive 93/67/EEC for aquatic organisms, chemicals are classified by their degree of toxicity based on EC50 values. We hypothesised that this classification was correlated with IC50 values and revealed that MWCNT and SWCNT samples might be characterised as extremely toxic and very toxic, respectively. Due to its technical simplicity, rapid response time and high sensitivity, this bioluminescent method has the potential to be developed as a general enzyme inhibition-based assay for a wide variety of nanomaterials. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

WE213 Delayed chlorophyll fluorescence in biomonitoring of environmental pollution

Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; E. Stravinskene, O. Kryuchkova, N. Pakharkova, Siberian Federal University

Plants have important role in biomonitoring of environmental pollution because of their high sensitivity to various pollutants which often disturb photosynthesis. The photosynthetic function of plants is therefore a good indicator to reveal the pollution effects. Fluorescence of chlorophyll is widely used for quick assessment of photosynthesis condition. A prompt fluorescence that can be registered by PAM fluorimeters is most commonly used for these purposes. Recently, we have developed a more sensitive and fast indicator of the state of the photosynthetic apparatus of plants, which is based on the measurement of delayed fluorescence (DF) of chlorophyll. Delayed fluorescence is registered in red spectrum area after exciting light flashes in the form of time-attenuated radiation. We found out that the ratio of DF excited by high intensity flashes to DF excited by low intensity flashes decreases more than tenfold when there is a toxic effect on photosynthesis. This indicator can be measured within a few seconds. Due to the relative nature of this indicator, which characterizes the photosynthetic activity of the plant test organism, it does not depend on the size or volume of analyzed sample. To implement this method, we developed the Photon 10 fluorimeter which automatically measures the relative indicator of delayed fluorescence (RIDF) in 24 plant samples. Simultaneously with RIDF, the device registers the variable part of prompt fluorescence of these samples. Applying this device we carried out transplanted lichen indication of air pollution in Krasnoyarsk. We found that the values of DF of several species of lichen differed up to 20 times between ecologically clean and industrial areas of the city after three weeks of the exposure. The study of the condition of pine needles in these areas showed a difference in the value of the RIDF up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorella vulgaris alga was used as a test organism. RIDF of Chlorella vulgaris suspension decreased by the factor of 2 (EC50 = 60 mg/L) in solutions of copper and zinc ions at a concentration of these heavy metals of 0.005 and 0.5 mg/dm³ respectively.

WE214 Chlorophyll fluorescence temperature curve to estimate changes of the photosynthetic apparatus of coniferous trees during the transition to a state of winter dormancy in urban ecosystems

N. Pakharkova, Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; N. Gaevsky, Siberian Federal University

The main regulating factor for the transition of plants from active vegetation to winter dormancy is the temperature. Changes in the temperature factor and air pollution also have a significant influence both during the autumn photoperiodic reaction and at different phases of winter dormancy. This research aims towards a better understanding of the responses of the Scots pine and the Siberian spruce to air pollution stress in urban and semi-urban conditions of Southern Siberia. It is well-established that during the transition from the phase of acclimation into the phase of dormancy the intercellular spaces of the pith are filled by parenchyma of needles undergo a number of changes. Changes in the assembly of the photosynthetic apparatus are mirrored in changes of fluorescent signals emitted at different temperatures. Chlorophyll fluorescence temperature curve (FTC) is a dependence of chlorophyll fluorescence intensity on linearly increasing temperature. This curve is used for determination of the stability of PS2 and for evaluation of the structural rearrangement of chloroplasts in vegetating plants. Also, based on the changes in the shape of the FTC it can be deduced whether the plant is in the state of winter dormancy or it is vegetating. The calculated ratio of the low and high-temperature peaks (50° and 70°) of zero level fluorescence may be used
as an indicator of the degree of dormancy. FTC was measured with the needles’ segments using fluorometer Junior-PAM (Walz, Germany). The needles were linearly heated from 25 to 70°C at a rate of 2°C/min using a computer-controlled heating device. In climate conditions of Southern Siberia, disturbance of winter dormancy under air pollution stress represents a major threat to the health status of Pinus sylvestris and Picea obovata. Our data demonstrate that regardless of age of needle and dormancy depth of both species clearly correlated with air pollution levels, and the trees growing in industrial areas are easier to release from dormancy and to be affected by late winter or spring frost. In urban environments the risk of frost injuries is even higher due to early spring warm spells associated with heat island effect. Scots pine is less susceptible to air pollution and temperature fluctuations than Siberian spruce, and therefore represents a better choice for urban forestry projects.

WE215 Luminous microscopy in the bioindication of the Baikal pollution with oil products and polyaromatic hydrocarbons
M.N. Saksonov, A.E. Balayan, Irkutsk State University / Research Institute of Biology of Irkutsk State University; O.A. Barkhatova, Irkutsk State University / Faculty of Geography; A.D. Stom, Irkutsk State University / Research Institute of Biology of Irkutsk State University

Against the backdrop of the growing diversity of toxic substances that degrade the natural environment, the creation of new analytical systems for assessing the state of the environment is of paramount importance. Among such systems is a luminescent microscope. It has been experimentally revealed that the many pollutants of water bodies, it is necessary to isolate oil products and polyaromatic compounds (PAHs), the flow of which in the valley is constantly increasing. On Lake Baikal, this is due to the development of tourism, the increase in the number of passenger ships and tourist bases, often not equipped with treatment facilities. The necessary system for monitoring the quality of the aquatic environment, including methods for biotest areas and bioindication, not only on generally accepted test facilities, but also on representative hydrobionts for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Epischura baikalensis Sars (Copepoda, Copepoda) - endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. baikalensis accounts for up to 70% of the total biomass of zooplankton. Copepods having fat inclusions, accumulate in them oil products. This can, in particular, be observed by the blue-violet glow in a luminescent microscope. The accumulation of diesel fuel by fatty inclusions of Copepoda crustaceans and the high sensitivity of luminous microscopy make it possible to monitor the pollution of this pollutant in the water under investigation. It is noted that in the presence of unicellular algae that are absorbed by the crustaceans, this process is activated and the accumulation time of oil products and PAHs decreases. Another representative of the Copepoda Cyclops Colensis also has chaotically scattered fatty inclusions in which the accumulation of oil products can be seen in a luminescent microscope. It has been experimentally revealed that E. baikalensis with oil products or PAHs accumulated in fatty inclusions is added to pure water to C. Colensis, then the staining of fat inclusions also occurs in the latter, that is, this process is transmitted along the trophic chain. Based on these experiments, a method of bioindication on the accumulation of oil products and PAHs in ?copepoda crustaceans in fat drops was proposed.

WE216 The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay
E. Nemtseeva, O. Chmurina, Siberian Federal University / Laboratory of Bioluminescent Biotechnologies; M. Gerasimova, Siberian Federal University / School of Engineering Physics and Radio Electronics; V. Kratasyuk, Siberian Federal University / Biophysical

The work is devoted to the development of the bioluminescent enzymatic bioassay of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of their contamination was under consideration. The main goal of this work was to assess sensitivity of the bioluminescent characteristics of the various soil samples and the results of their bioluminescent bioassay as well as their physico-chemical characteristics. Water extracts from 56 soils (medium and heavy loams, with humus content 1.2-15.39 mg/kg) were studied by the method of excitation-emission matrix (EEm) fluorescence spectroscopy. The luminescence in the range of 290-600 nm under excitation at 250-450 nm was measured for each extract as well as absorption spectra in the range 200-800 nm. The physico-chemical characteristics of the soils (particle size distributions, pH, humus content, etc.) were compared with the inhibitory effect of water soil extracts on enzymatic bioassay based on the coupled bioluminescent reaction of bacterial luciferase and NAD(P)H:FMN-oxidoreductase. It was revealed that the spectral-luminescent characteristics of water extracts are similar for all soils and featured by three types of fluorophores with excitation maxima at about 270, 330 and 360 nm and emission maxima at about 330, 425 and 470 nm, respectively. The residual activity of the bioluminescent bioassay enzymes in the presence of soil extracts was found to correlate with intensity of two first bands that is the measure of the component content. Poor correlation was found between EEm characteristics and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of bioassay signal from studied extracts with the amount of humic substances in soils. The research was supported by the Russian Science Foundation (project no. 16-14-10115).

WE217 The comparison of enzyme systems for soil contamination bioassay
E. Kolosnova, Siberian Federal University / Biophysical; D. Gulnov, Siberian Federal University; N. Rimatskaia, Siberian Federal University / Biophysical; A. Listissa, O. Sutormin, V. Kratasyuk, Siberian Federal University

Despite the fact, simple highly sensitive bioluminescent test is extremely necessary for ecological soil monitoring. Enzyme systems may be a perspective basis for the development of modern methods of bioassay. With sets of enzymes, it is possible to simulate the effect of toxic substances present in natural environments on living organisms. Moreover, coupling enzyme-target with bacterial luciferase provides advantages in the signal detection. The purpose of this study is to evaluate the possibility of using various enzymatic systems for the analysis of soil contamination. In this work NADH: FMN-oxidoreductase, alcohol dehydrogenase (ADH), NADH: FMN-oxidoreductase + bacterial luciferase (two-enzyme system), NADH: FMN-oxidoreductase + bacterial luciferase + alcohol dehydrogenase (three-enzyme system) were examined. The enzyme activities were measured by addition of the model soil pollutants such as a blue copperas, the insect powder “Pest Profil” (Bayer CropScience) and diesel fuel. The values of the toxicological parameters (concentrations of the pollutants causing the system inhibition by 20% and 50% respectively) were determined. The sensitivity of each enzymatic test system to the aqueous extract of soil was also analysed. The blue copperas (II) – water solution shows an inhibitory effect on all enzymatic systems. The value of EC50 is from 0.088 to 8.75 mΜ. The insect powder-water solution also shows an inhibitory effect on all enzymatic systems except ADH enzyme system. In contrast, the diesel fuel impacts only on enzyme systems coupled with bacterial luciferase. As a result the blue copperas (II) – water solution decreases catalytic activities all enzyme systems; the insect powder-water solution decreases only NADH: FMN-oxidoreductase catalytic activity; the diesel fuel decreases luciferase activity. The addition of aqueous extract of soil leads to activation of catalytic activity of NADH: FMN-oxidoreductase; for the two- and three-enzyme systems the addition of the aqueous extract of soil leads to inhibition of catalytic activities of the enzyme systems (more than 50%). The NADH: FMN-oxidoreductase + bacterial luciferase enzyme system showed the greater sensitivity to the soil pollutants than other systems. This fact is confirmed the possibility of using this system for environmental monitoring. *The study was supported by a grant from the Russian Science Foundation (project No. 16-14-10115).

WE218 Are changes in bioluminescence kinetics of Photobacterium phosphoreum enzyme systems to low-dose radiation connected with genetic mutations? O. Gaseynov, V. Gaseynova, Siberian Federal University; T. Rozhko, Krasnoyarsk State Medical University. prof. VF Voyno-Yasenetsky; A. Bondar, Institute of Chemical Biology and Fundamental Medicine SB RAS; N. Kudryasheva, Institute of Biophysics SB RAS

Luminous bacteria of marine origin are widely employed as biological sensors for monitoring the living organisms. This is due to the low sensitivity to the soil pollutants than other systems. This fact is confirmed the possibility of using this system for environmental monitoring. *The study was supported by a grant from the Russian Science Foundation (project No. 16-14-10115).
LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (P)

WE219
Meet the Framework Regulation and Supply Chain Secondary standards in wheat cultivation for sustainable pasta production. An example of broadleaf weed control: halaluxif-en-methyl (Arylex™ active)
C. Vaj, S. Cavana, Dow AgroSciences Italia srl; A. Haley, Dow AgroSciences Ltd; W. Jones, DuPont

The need and the awareness of sustainable food production has increased in recent years and driven by the growing awareness of global population increase and its burden on the limited agricultural land available to sustain the required food production. This is being reflected in the choices made at all the steps of food production from field to table. The sustainable production of pasta starts by optimising agricultural practices, which includes the key component of Plant Protection Products (PPP) applied to wheat crops. The development of new Plant Protection Products in Europe is governed by the strictest regulatory framework in the world: Regulation (EC) 1107/2009 concerning the placing of plant production products on the EU market; Directive 2009/128/EC on Sustainable Use of pesticides and its national implementations (National Action Plans), and Regulation (EC) 396/2005 concerning the Maximum Residue Levels of plant protection products allowed in food. In addition, the Secondary standards coming from Food Processors and Retailers regarding chemical residues in food place increasing standards which have to be considered. The Plant Protection Industry is increasing its focus on sustainable food production not only for complying with the evolving Regulations, but also for helping the farmer to meet the Food Supply Chain needs. A good example of this new emphasis is brought by an innovative auxinic herbicide, halaluxifen-methyl (Arylex™ active), for use in spring and winter soft and durum wheat. This highly efficacious herbicide requires low use rates and its inherent properties (rapid degradation in the soil and plant) mean a low environmental and human health impact. Utilising halaluxifen-methyl according to its label offers wheat growers a key tool for optimizing production, while producing a commodity with no detectable residues in the grain, in the processed product (flour, bread, wheat germ, malt), and in pasta. Results will be presented and discussed. Therefore, the properties of halaluxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards.

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WE220
Crable to grave Life Cycle Assessment of Traditional and Vegetative roofs
J. Koura, University of Balamand / Department of Chemical Engineering; A. Núñez, FEGAMP; M. Bilec, University of Pittsburgh / Civil Engineering; A. Núñez, L. González Louro, FEGAMP; Santiago de Compostela; E. Andrade, Universidade de Santiago de Compostela; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; F. García, University of Santiago de Compostela CIF Q1518001A / Chemical Engineering

Urban systems can be considered as living organisms driven by materials and energy flows (urban metabolism). Once these flows are computed, the environmental profile of the city can be analysed. However, when only assessing the environmental aspects of cities, a limited view of their performance is possible, as they are complex systems in which social and economic aspects are at least as important as environmental ones. This fact raises a dilemma, since today’s developed society bases its social and economic well-being on the continuous consumption of resources and, therefore, on causing a large impact on the environment. The definition of sustainability includes three main pillars: society, economy and environment. However, considering the social and economic aspects of urban metabolism, two main gaps emerge. The first one is the lack of standardisation. Indicators are used to evaluate these aspects, but different specialized organisms propose different sets of indicators. The second gap is the difficulty of comparing indicators to each other in order to evaluate which city is the most sustainable in a sample. This study aims to fill both gaps by systematically assessing the sustainability of several cities in Galicia (NW Spain). To select an appropriate set of indicators, including environmental, social and economic criteria, a Leopold matrix has been constructed considering: i) the data available for the systems under study, ii) the frequency of occurrence in the data sets specialized agencies (United Nations, European Commission, OECD and The World Bank) and iii) the relevance for the case study. The selected indicators do not have a significant common unit of measurement; therefore, to obtain a common scale for comparisons, all indicators should be normalized. In this study, this have been done by considering unsustainable and sustainable values as reference (Phillis et al., 2017). Finally, a composite indicator, i.e. a sustainability index, is obtained for each city based on the three composite sub-indicators of the sustainability dimensions (environmental, social and economic criteria). Acknowledgements This work was financially supported by the Spanish Ministry of Economy and Competitiveness (project ref. CTQ2016-75136-P) and by Xunta de Galicia (project ref. ED431F 2016/001). Dr. S. González-García would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness for financial support (Grant reference RYC-2014-14984).

WE223
Life Cycle Analysis of remediation solutions in railways and surrounding areas
M. Riera, Leitat Technological Center

An important environmental problem is the pollution associated with trains on external or underground railways. Despite is an issue less studied, a real contamination by heavy metals and hydrocarbons exists in railways, affecting also the surrounding areas. Following the strategic line of Horizon 2020, RECOVER project aims to develop new technologies to reduce the environmental impact of transport systems. The project is executed by COMSA, CETIM and LEITAT, and is within the framework of the call "Challenges of Collaboration" in 2015, with partial funding from the Ministry of Economy and Competitiveness of Spain. The
main aim of the project is to develop systems for the collection and elimination of pollutants (hydrocarbons and heavy metals) present in the ballast and on the ground adjacent to the railway tracks through the use of different technologies: Ballast modified by sol-gel coating based on silicon oxide to capture heavy metals and titanium oxide for the degradation of hydrocarbons. Phytoremediation processes (use of plants to decontaminate soils) and bioremediation (bioaugmentation of the microbial populations in the soil) for the uptake of heavy metals and hydrocarbons in the soil adjacent to the roads. The solutions are first performed at the laboratory scale, and subsequently they are located in a real area to evaluate their effectiveness. The remediation procedures are assessed through a comprehensive Life Cycle Assessment (LCA) to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, application of technologies and end of life scenarios, including transport and other related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefitted of the pollutants reducton in the soil, the LCA allows the identification of other environmental aspects. The impact categories and indicators used in the analysis are: Acidification, Ozone Depletion, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Ecotoxicity. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.

WE224
Life Cycle Assessment of Asphalt Mixtures vs Road Pavements
D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; A. Jimenez del Barco Carrion, The University of Nottingham

Road infrastructures are one of the major assets all over the world. The appropriate construction and maintenance of roads promote economic growth and development of countries. Within the field of road infrastructures, road pavements construction and maintenance require particularly high energy and raw materials consumption and generate elevated GHG emissions. For this reason, great efforts are being made in the last years towards the implementation of sustainable techniques and operations, and decision-making tools are essential to help authorities to accept them. In this regard, LCA has become popular in pavement engineering but there is still a lack of detailed, consensus (especially in terms of system boundaries) and reliable data. Beyond ISO 14040:2006, ISO 14044:2006, ISO/TS 14067:2013, EN 15980:2012 and GHG Protocol 2013, there is no specific methodology for selecting the parameters and activities that should be included in either asphalt mixtures or road pavements LCA. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. The study presented here aims at highlighting the differences between the LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE225
Sustainability assessment of an integrated innovative wastewater and greywater system for an optimal and safe closed water cycle in Mediterranean tourist facilities: demEAUmed solution
A. Claret, C. Hidalgo, Leitat Technological Centre / Sustainability Division; S. Varela, ACETO TANGER 2000 S.A. / ACETO TANGER 2000 S.A.; C. Hidalgo, LEITAT TECHNOLOGICAL CENTER / Sustainability Division

The main objective of demEAUmed is to tackle water scarcity in the Mediterranean area, especially in places with high tourist activity. Also, the project wants to foster the incorporation of sustainability aspects in the tourism sector. To achieve both challenges, demEAUmed has demonstrated the integration of innovative wastewater/greywater technologies to have an optimized and safe closed water cycle in Mediterranean tourist facilities. Water resources are limited and unequally distributed geographically and among the year seasons, with higher pressure during summer, in Mediterranean regions. For instance, water consumption per guest has been estimated at 222 L/day in hotels in Spain. So, it is of great importance to achieve a holistic water resource management. DemEAUmed affords the reuse of greywater and wastewater generated in tourist facilities with an integrated approach bringing environmental benefits such as water savings and water management carbon footprint reduction. 8 different innovative technologies with an advanced monitoring, control and decision support system have been integrated and implemented on the demonstration site: Samba Hotel-Lloret de Mar, Catalonia, Spain. These technologies have been assessed through a comprehensive LCA, assessing the impacts for each individual technology and for the demo-site integration (7 different configurations). Besides the LCA, a Life Cycle Costing (LCC) is being performed in order to analyse the economic costs. A social LCA (S-LCA) is also conducted in order to assess the social impacts generated by demEAUmed. Life cycle stages of construction and operation are addressed through a LCA and S-LCA. Finally, the results determined that the technologies and combined configurations have achieved important environmental impact savings thanks to the greywater/wastewater recovery and water reuse. As an example, for demEAUmed combined strategies, the carbon footprint is reduced up to 136% (greywater scenario) or up to 62% (wastewater scenario) thanks to water reuse. Focusing on the technologies, main environmental impacts are localized on the operation stage, due to electricity consumption. Concerning the LCC, the overall cost of treating one cubic meter (1m³) of greywater or wastewater by the demEAUmed technologies along their life cycle are being determined. Finally, S-LCA has presented some indicators and the quantification of the socioeconomic impacts and benefits provided by demEAUmed solution.
needs and also higher conversion efficiencies and synergas quality. All the environmental categories depict negative values, meaning environmental savings as well as each tonne of treated residues redeeming more than 500 tons of emissions. Two-stage plasma gasification proved to be the most effective method, within the assessed techniques. Keywords: waste-to-energy, sustainability, life cycle assessment, solid residues Assessment on the environment being estimated for paracetamol within the range 7.63 mg/person/day (sewage after sink and toilet disposal) to 76.52 mg/person/day (wastewater after excretion). Based on the survey data, a life cycle assessment study was performed to assess the broader environmental impacts of typical medicinal waste disposal management practices in the UK. The functional unit of this study was 1 tonne of pharmaceutical waste generated in the UK. Three scenarios and treatments explored: incineration after returning back to the pharmacy; landfill treatment after rubbish disposal; and wastewater treatment after toilet and sink disposal. For the life cycle inventory (LCI) phase, two types of databases were used in the study: primary data from the survey study and secondary data from the ecoinvent database. Most of the datasets used in this study are from the whole of Europe (ERB) or the United Kingdom (GB). To carry out the life cycle impact assessment (LCIA) phase, the method that has been considered is LCID 1.08 2016 midpoint with APis. Meanwhile, USETox 2.0 was also used in this study to calculate characterisation factors for the APis that were not commonly used in the previous study. Furthermore, the impact categories that were considered for this study are climate change, ecosystem quality, human health and resources. The study is still ongoing and the results will be presented at the event. The CO₂ emissions embedded in international trade have rapidly increased in countries with lax environmental regulations with expansion of trade and the emission from China and Russia which are (FTT member countries is reduced). Therefore, a new methodological approach has been identified as a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burdens simultaneously through the cooperation between the participating countries. To decide the cooperation policy for reducing environmental burden, it needs to understand the structure of complicated supply chain network. However, to the best of our knowledge, previous studies did not analyze the supply chain network analysis, environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). About 100 products and services are evaluated by using this calculation tool. However, the case number of studies using hotspots analysis tool are few, advantages and limitations are unknown. In this research, the usefulness of environmental hotspots analysis through a variety of case studies for Japanese products. The CO₂ emissions embedded in international trade have rapidly increased in countries with lax environmental regulations with expansion of trade and the emission from China and Russia which are (FTT member countries is reduced). Therefore, a new methodological approach has been identified as a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burdens simultaneously through the cooperation between the participating countries. To decide the cooperation policy for reducing environmental burden, it needs to understand the structure of complicated supply chain network. However, to the best of our knowledge, previous studies did not analyze the supply chain network analysis, environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). About 100 products and services are evaluated by using this calculation tool. However, the case number of studies using hotspots analysis tool are few, advantages and limitations are unknown. In this research, the usefulness of environmental hotspots analysis through a variety of case studies for Japanese products.
models in consequential LCA. None of the approaches presented resulted fully comprehensive, with limited uncertainty and complexity. Both approaches based on agent based modelling require a large amount of data and expertise to be used, not often available to the LCA practitioner. The weighted consequential approach has a level of subjectivity higher than other approaches. Instead, the scenario based approach using IAM has a medium level of completeness, uncertainty and complexity. However, a shortcoming of the scenario based approach is the lack of agreement with the IAM assumptions to be used and this constitutes a major limit. The choice among the approaches depends on the objectives of the LCA and should be as complete and comprehensive as possible when climate change claims are made. Future perspectives include a comparative testing of these approaches for selected GGRT and future research should develop and assess potential alternative approaches to those presented. Further research is necessary to develop the appropriate LCA methodology for GGRT.

**WE235**

**HYBRID FULFILMENT-IMPORTANCE MATRIX FOR ASSESSING SOCIOECONOMIC IMPACT**

I. Escrig Gallart, Fundació CMT; Centro Tecnológico; I. Bezzova, L. Vendrell, Fundación CMT; Centre; F. Clares, Fundació CMT; Centro Tecnological

More often, methodologies to assess socioeconomic impact are focused just on determining just a few indicators instead impacts, which don’t use the whole spectrum of socioeconomic insights. In this sense, the hybrid fulfilment-importance matrix emerges with the aim to solve these limitations and to consider the socio-indicators, those listed come from sLCA study. The distribution of the economic impacts have the higher contribution. Instead, the scenario based classification for the mapping, the heavy metals maps for the survey 2015 do not any longer depict much spatial variation. Therefore, in an upcoming study, this analysis needs to be complemented for the heavy metals by mapping percentile statistics for the whole period 1990-2015 with maps depicting the spatial structure of survey-specific percentile statistics 1990, 1995, 2000, 2005, and 2015.

**Keywords:** Atmospheric Deposition, European Moss Survey, Geostatistics, Kriging Interpolation, Mapping, Variogram Analysis.

**References**


**Acknowledgement** - The authors acknowledge the German Environment Agency for funding.

**WE236**

**SETAC Sustainability Interest Group**

D.L. Carr, Texas Tech University / Biological Sciences

**WE237**

**SETAC LCA Interest Group (Europe)**

H. Stichnoth, Thünen Institute / Agricultural Technology

**WE238**

**Life cycle assessment of a thermoplastic starch obtained from mango kernel**

A. Coelho, Embrapa Agroindústria e Energia, Research Corporation / Embraapa Energia; P. Marques, P. Freize, University of Coimbra / ADAI-LAETA, Mechanical Engineering; P. Melo, Federal University of Ceará; M. Figuerdo, Brazilian Agricultural Research Corporation Embraapa / Embraapa Tropical Agroindustry

Agri-food industry generates large amounts of residues with potential to be used as feedstocks for bio-based products. Mango kernel annual production in Brazil is expected to increase to 1.4 million tons by 2024, and processing residues can account for more than 40 %. The mango pulp is the main product, and mango kernel, a so-called residue, is disposed of at landfill, but containing starch, oil and phenolic substances. This study assesses the environmental life cycle impacts of thermoplastic starch produced from mango kernel (MK-TPS), and compare it with feedstock low-density polyethylene (LDPE). The system boundaries of the MK-TPS start with transportation of mango kernel residue, followed by extraction of starch from mango kernel (together with oil and phenolic substances), and production of thermoplastic. The functional unit adopted was 1 kg of thermoplastic.

**WE239**

**Geostatistically estimating spatial structures of heavy metals and nitrogen accumulation in mosses sampled between 1990 and 2015 throughout Germany**

I. Bezzova, L. Vendrell, M. Moeenfar, D. L. Carr, Fundació CMT Centre Tecnologic; F. Clarens, Fundacio CTM Centre Tecnologic; J. Espí Gallart, Fundacio CTM Centre Tecnologic;
P. Marques, F. Freire, University of Coimbra / SETAC Sustainability Interest Group

Environmental monitoring of contaminants using terrestrial ecological biomonitors (P)

Semivolatile organic compounds (SVOCs) in pine needles from Iceland M. Moeenfar, J.A. Silva, S. Ramos, LEPABE University of Porto; H. Ingason, T. Eyfeinstein, T. Jönsson, A. Sigurgeirsson, Icelandic Forest Research; N. Ratola, Faculty of Engineering - University of Porto / Laboratory for Process Engineering Environment, Biotechnology and Energy

Iceland is famous for a great number of things, but vegetation (particularly forestry) is not one of them. However, trees do exist in this country and pine stands and rural areas but also in the coastal areas of Iceland. Research for the biomonitoring of compounds such as the semi-volatile organic contaminants (SVOCs). The most common species are somewhat different from those used more frequently in these kinds of studies, but offer nevertheless the same performance and possibilities. Pinus contorta, Pinus mugo, Pinus sylvestris and Pinus cembra needles were collected upon availability in 24 sampling sites that included remote and rural areas but also in the coastal areas of Iceland. In order to use these needles it was possible to collect needles from more than one species, allowing a comparison between their respective uptake abilities for SVOCs. In this work the levels of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), organochlorine pesticides (OCPs) and musks were analysed and allowed an original description of the status of the art of these compounds in this remote location. Acknowledgements: This work was the result of the project: (i) POCI-01-0145-FEDER-006939 (LEPABE – UID/EQUI/00511/2013) funded by the European Regional
The use of lichens as biomonitors of air quality is inexpensive and effective. Minimal variability due to abiotic climate factors (solar radiation and temperature). We show that detectable seasonal patterns in the mercury accumulation on lichens. We also collected and analyzed mercury (THg); a subset of these samples were analyzed for other trace metals, including arsenic in sediment. The relative contribution of local and national trends of this background contamination. Some organisms. The observed concentrations will also be compared to past levels of pollutants, there is still a gap of knowledge on their toxicological mechanisms and possible influence of other chemical pollutants. Persistent organic pollutants are incorporated to remote high mountain areas through atmospheric transport and deposition, where they accumulate in the lichen. Active and passive monitoring devices were used for air and water sampling in order to get insight on the presence and environmental fate of organic contaminants over an extended time period. Moreover, brown trout (Salmo trutta) specimens were captured in each lake for bio-monitoring. They were analyzed for contaminants in the muscle, hepatopancreas and gallbladder tissue. The transcriptomic and proteomic analysis of mRNA was also performed to link the levels of pollutants found in these remote high mountains to the effects in these organisms. The observed concentrations will also be compared to past measurements in other high mountain environments for assessment of temporal trends of this background contamination. Background fish. Mercury is a persistent pollutant present in all ecosystems. The prevalence and spatial distribution of mercury will determine its movement in the atmosphere and potential to bioaccumulate and biomagnify through food webs leading to mercury bioaccumulation in top predator organisms. Monitoring of mercury and other trace metals can be costly, whereas the use of naturally occurring epiphytic lichens can be an effective tool for these types of studies. Nova Scotia, Canada is a hotspot for mercury and other trace metal accumulation in ecosystems, partially attributed to long-range transport of anthropogenic air pollution. The region also contains a number of historic gold mining sites that are known to have persistent high levels of mercury and arsenic in sediment. The relative contribution of local and national sources of mercury to local air is unknown. This work aimed to address which elements can be effectively biomonitored through lichens. Trace metals in lichens other than mercury may also help elucidate the potential sources of these elements: whether from geological, re-emission, or long-range transport. Over 300 lichen (Usnea spp.) samples were collected across Nova Scotia and analyzed for total mercury (THg); a subset of these samples were analyzed for other trace metals, including arsenic, nickel, copper, cadmium, lead, and selenium (n=163). Average THg concentrations were 365 ± 391 ppb (n=340). Significant variation in mercury concentrations was observed along a central coastal transect. We hypothesized that our data would vary along this transect, and model these regional trends. While broad spatial resolution was the initial focus for these collections, a few target areas (biological mercury hotspot Kejimkujik National Park and historical gold mining areas) were also sampled in more intensive to confirm spatial patterns. Lichens were also collected from one old growth forest site weekly for a one year period to investigate if there were detectable seasonal patterns in the mercury accumulation on lichens. We show that the association between mercury and lichens is stable over a one year period with minimal variability due to abiotic climate factors (solar radiation and temperature). The use of lichens as biomarkers of air quality is inexpensive and effective.
Biochemical and behavioural responses in two endogeic earthworm species exposed to parathion

E. Jouni, UAPV/IMBE; J. Sanchez-Hernandez, University of Castilla La Mancha; C. Mazzia, University of Avignon / Biologie; M. Johnin, University of Avignon; Y. Capowiez, INRA Avignon; M. Rault, University of Avignon

The earthworm species Eisenia fetida is a common organism in the soil toxicity testing framework, however, recent studies have point out endogeic species are more sensitive to pesticide than E. fetida. Moreover, interspecific differences in the response of this ecological group of earthworms to agrochemicals should be investigated for a better understanding of pesticide impact at population level. Herein, two endogeic and abundant species in the agroecosystem (Allolobophora chlorotica and Aporrectodea caliginosa) were incubated in Oleabladan® (ethyl parathion)-contaminated soils. Behavioural (burrowing, casting and feeding, this latter assessed through earthworm mass changes) and biochemical (acetylcholinesterase [AChE] and carboxylesterase [CbE] activities) were measured after 7 days of pesticide exposure. Our results clearly showed specific and different effects on both species, indicating A. caliginosa the most sensitive species to this pesticide under the exposure conditions of our study. Although CbE activity was determined in an attempt to account for these interspecific differences because the implication of this esterase activity in organophosphate detoxification, we found that CbE activity of both species had the OP sensitivity. However, an in vitro inhibition trial with ethyl paraoxon evidenced a higher sensitivity of A. caliginosa AChE activity compared with that of A. chlorotica, which suggested that this toxicological endpoint may contribute to the interspecific differences of behavioural responses such as cast production rate. Our findings suggest the use of more than one endogeic earthworm species to assess toxicity from organophosphate insecticides, overall when these earthworms have a beneficial impact on soil fertility.

Cr transport in sweet peppers plants cultivated with vermicomposted tannery wastes

M. Rezende, Universidade de Sao Paulo / Chemistry; R.R. Rachide Nunes, Federal Rural University of Pernambuco / Chemistry; T. Oliveira, University of Sao Paulo / Chemistry; R.M. Bontempi, USP - Universidade de Sao Paulo / IQSC Instituto de Ciência de São Carlos

Untreated waste water and solid waste generated by the tannery industry can cause serious environment damage, particularly to surface and groundwater. In order to avoid pollution, specific chemical, physical and biological treatments have been adopted to reduce waste toxicity, caused mainly by the presence of the chromium. Chromium exists in oxidation states of Cr(III) and Cr(VI). As it is well known, the trivalent oxidation state is the most stable form of chromium and it is essential to plants in trace concentrations. In other hand, the hexavalent is toxic and carcinogenic to mammals, even in small concentrations. Thus, the aim of this work was to investigate the Cr transport in sweet peppers cultivated with vermicompost. In order to investigate Cr transport from the vermicomposts and its possible transportation through the plant, the content of Cr(III) and Cr(VI) were determined through graphite furnace atomic absorption spectroscopy (GF AAS). Values of Cr(VI) were below the detectable level (LOQ) in all the analysis. In general, all treatments showed a decrease on their Cr (III) content during the sweet pepper cultivation. The concentration of Cr (III) varied in leaves < stalks < roots < fruits. Values of chromium were in accordance with the maximum permitted in the Brazilian legislation for food security; Cr (VI) was not reported in any sample. A significant quantity of Cr (III) decreased between the concentration at the beginning and at final experiments (post-harvest). Assessing the dynamics of the Cr (III), root and foliar contents showed a higher Cr transport to the leaves than in the stalks. Differences in the chromium contents were not observed between samples and treatments which received vermicomposted tannery wastes with others, without addition of chromium residues. Keywords: vermicomposting; tannery wastes; chromium; sweet pepper

Insecticide resistance in the natural enemy F. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide.

A. Le Navenant, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unité PSH, UAPV/IMBE / IMBE UAPV UMR 7263, Pôle Agrosciences; J. Sanchez-Hernandez, University of Avignon / Biologie, INRA Avignon; M. Rault, UAPV/IMBE / IMBE UAPV UMR 7263, Pôle Agrosciences

Apple orchards are highly treated crops, in which organophosphorus (OP), neonicotinoid and synthetic pyrethroid insecticides were heavily sprayed insecticides. These compounds are toxic to non-target arthropods and increase the risk of resistance making apple orchards an interesting case to study the deleterious effects of OP insecticides on non-target species. In the context of reduced pesticide use, the development of biocontrol agents has to be promoted. This work focuses on the assessment of the resistance/tolerance to OP insecticide of the earwig Forficula auricularia, an effective generalist predator. The threshold activities of enzymes that belong to detoxification pathways involved in insecticide resistance were estimated depending on the origin of earwigs. Then, variations in those activities were assessed under environmental conditions prior and after exposure to normal application rate of chlorpyrifos. Adult earwigs were sampled in apple orchards conducted under different management strategies: conventional, Integrated Pest Management (IPM), reduced pesticide use thanks to mating.
disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathione-S-transferases (GST) and Carboxylesterases (ChEs) were studied, by measuring their activities on earvic extracts. Acetylcholinesterase (AChE) activity, the molecular target of OP insecticides, was monitored as toxicological endpoint. We observed that the mortality rate of adult earwigs exposed to the authorized dose of chlorpyrifos depends on their origin, with lower mortality in conventional orchards. AChE activity appears to be highly inhibited in earwigs from organic or IPM compared to conventional orchards. Moreover AChE inhibition increased when earwigs were exposed to both chlorpyrifos combined to a specific inhibitor of ChEs. Moreover, we observed that basa-activities of ChEs and GST of unexposed individuals are higher in conventional orchards compared to IPM and organic ones. All these observations suggest the hypothesis of a molecular target modification in AChE decreasing to a degree of affinity with the insecticide, and highlight the role of ChEs ensuring effective protection of AChE. Our findings suggest the acquisition of resistance to chlorpyrifos in earwigs caught in conventional orchards and point out the necessity to understand these mechanisms in order to evaluate their relevance as biocontrol agents.

WE251
Bioaccumulation of persistent halogenated organic pollutants in insects: Common alterations to the pollutant pattern for different insects during metamorphosis
L. Yu, Guangzhou Institute of Geochemistry / State Key Laboratory of Organic Geochemistry and Guangdong Key Laboratory of Environmental Resources Utilization and Protection; X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem.; L. Tao, Guangzhou institute of Geochemistry Chinese Academy of Sciences; Y. Zeng, B. Mai, Guangzhou Institute of Geochemistry Ubiquitous use of halogenated organic pollutants (HOPs), such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and dichlorodiphenyltrichloroethanes (DDTs), can accumulate in organisms and become magnified along the food chain. Insects play an important role in the transformation of pollutants from abiotic to biotic media. However, few studies have been discussed the accumulation and fate of contaminants in insects. Furthermore, metamorphosis effects on the stable isototope signatures and enrichment characteristic of contaminants in insects, but the bioaccumulation pattern and mechanism during metamorphosis is not well understood. Therefore, we detected the concentrations of halogenated organic pollutants in four taxonomic insects (dragonfly, butterfly and moth, grasshopper, and litchi stinkbug), including three kinds of metamorphosis type, collected from an e-waste pollution region in South China. Stable isotopic analysis showed grasshopper have the highest δ13C values, indicating a C4-plant-based food source. In contrast, the butterfly, moth, and litchi stinkbug all represent a C3-based diet preference characterized by lower δ13C values. Moreover, enrichment of the heavy N isotope during metamorphosis is observed in the dragonfly and litchi stinkbug, but the other species (grasshopper, butterfly and moth) did not show significant increases in the values of δ15N from larvae to adults. Principal component analysis (PCA) was conducted using the fraction c

WE252
Glyphosate: toxic or not toxic, this is the question
M. Verderano, R. Scudiero, University Federico II / Department of Biology Insect pest pressure and the reduction of biodiversity (GRH), a broad spectrum herbicide widely used in agricultural, industrial and urban areas, is a great matter of debate. Although classified by the EPA as “non-toxic and not a irritant” and by the EFSA as “non carcinogenic to humans”, converging evidence suggests that GBHs, such as Roundup (Monsanto), pose serious health risk on target-non wildlife. Many studies demonstrate that GBHs threaten the reproduction environment and the biochemical processes. In insects, GBHs can affect the production of testosterone. Moreover, in vertebrates such fish and mammals GBHs cause the raise of oxidative stress markers and alterations in liver and kidney. Hence, the question about the real glyphosate (Gly) toxicity is still open. To concur to an answer to this question, we decided to investigate the effects of Gly exposure on the Italian wall lizard Podarcis sicula, a suitable biodiversity indicator of terrestrial environmental pollution. Adult P. sicula specimens were divided in 3 groups (n=6): group 1 and 2 were exposed to pure Gly 0.1 and 1 µg/L respectively, via gavage every other day for 3 weeks; group 3 received by gavage the same dose of tap water (100µl). The results demonstrate that both Gly doses are toxic for the liver that shows an increase of melanocytes degranulation and the appearance of nodular/cystic formations mainly consisting of collagen fibers, typical of hepatic fibrosis. The liver of Gly-treated males also displays the biosynthetic alterations typical of an estrogenic contamination: hepatocytes, in fact, contain transcripts for both vitellogenin and estrogen receptors. At reproductive level, male gonad is affected by the treatment. Spermato genesis is slightly slower, at low dose of Gly scattered spermatocytes II lusey forms cone-shaped arrangement, at high dose the angle of rosettes increase. Some spermidids are dispersed in parts and are evident in the lumen of the tubules. Alterations in the expression of estrogen and androgen receptors and aromatase are also detected. Interestingly, in females, the ovary is not affected by Gly exposure, no matter the dose. Our results suggest that Gly exposure in a terrestrial vertebrate commonly inhabiting the fields potentially exposed to GBHs causes tissue toxicity, with possible serious health implications for wild and breeding animals as well as man populations.

WE253
Concentration of perfluoralkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs
C. Del Mar, Università degli Studi di Milano; M. Mazzoni, University of Insubria, DISTA / Water Research Institute; B. De Felice, Università degli Studi di Milano; F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNRR; S. Polese, Water Research Institute- CNR / Water Research Institute; N. Saino, University of Milano; M. Parolini, University of Milan / Department of Environmental Science and Policy; S. Valsecchi, Water Research Institute - Italian National Research Council IRSA-CNRR; M. Fringuelli, University of Insubria
Perfluoralkyl substances (PFAS) are chemicals used as surface-active agents in diverse industrial applications. Because of their incessant disposal and release to the environment, these molecules caused the contamination of both fresh and seawaters, entailing their accumulation in the biota. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the marine food chain, and low bioaccumulative capacity, but other marine organisms as well can accumulate in birds be transferred to the offspring via their eggs, which are considered as good indicators of environmental pollution for a plethora of contaminants. However, the information concerning the maternal transfer of PFAS in bird eggs and the variation of their concentration according to the laying order is still inadequate. Thus, the aim of the present study was to determine the levels of PFAS in three-egg clutches of the yellow-legged gull (Larus michahellis) breeding in a colony located at the Comacchio lagoon (Northeastern Italy) and their variation according to the position in the laying sequence. Eleven perfluoralkyl acids (PFAA) were analyzed in the yolk of eggs sampled at the time of deposition from 15 three-egg clutches. Independently of the laying order, perfluorooctane sulfonate (PFOS) was the main component detected in the egg yolk, followed by perfluorooctanoic acid (PFOA) and perfluorodecanoic acid (PFDoDA). Overall, the ΣPFAA decreased according to the position in the laying sequence, with first- and second-laid eggs showing higher concentrations compared to last-laid eggs. A similar decreasing trend was also noticed for single compounds, namely PFOS, perfluororoonanic acid (PFNA), perfluorodecanoic acid (PFDA), perfluorooctanoic acid (PFOSA), perfluorooctanoic acid (PFPOA) and PFDoDA, with concentrations measured in the last-laid eggs that were significantly lower compared to those from the first- and second-laid eggs.

WE254
First assessment of metal concentration in the crab Goniopsis cruentata (Latreille, 1803) (Decapoda, Grapsidae) from two brazilian mangroves areas with different levels of contamination
M. Vedolin, Universidade de São Paulo USP; T.H. Trevizani, Universidade de Sao Paulo / Instituto Oceanográfico; M. Petti, University of Sao Paulo USP; R.C. Figuera, University of Sao Paulo USP / Institute of Oceanography The crab Goniopsis cruentata is a common semi-terrestrial species in brazilian mangroves. Its geographical range includes the western Atlantic Ocean from Bermuda to Brazil, and the eastern Atlantic Ocean from Senegal to Angola. The species is an important fishery resource for traditional communities in the some regions of Brazilian coast. These ecosystems are located in regions of intense anthropic activity and have been proved to accumulate heavy metals. The use of young birds as bioindicators of seawater contamination allows to outline comparisons over space and time and provides significant ecotoxicological integrated measures of the selected metals within the studied system. This study aimed to assess the levels of metals (As, Cd, Cu, Cr, Ni, Pb and Zn) in different tissues (muscle, hepatopancreas and gills) of G. cruentata and compare populations from contaminated and noncontaminated areas. Samples were collected in two mangrove areas in the state of São Paulo: São Pedro de Alcantara, a region impacted by urban development during a period of one year, to assess the bioaccumulation of metals associated with seasonality. A two-way ANOVA was carried to analyze interactions between season and sites. The results showed high concentrations of metals in the gills, which was considered a strong reflection of high exposure of G. cruentata to these contaminants. In general, the hierarchical pattern of metals concentration in organs was represented by gills>hepatopancreas> muscle, except for Zn. There were significant differences in metal levels between seasons and sites (p<0.05). The highest concentrations were observed in the summer, which corresponds to the period of greatest metabolic activity of the organisms. Surprisingly, organisms from
unpolluted regions, accumulated more metals than from polluted areas. Thus, we concluded that there are external factors (grain size, pH, salinity) that reduce the mobilization of these chemicals to the tissues and, consequently, their bioavailability to the local biota. Therefore, studies of metal concentrations in mangrove areas are relevant and useful for monitoring the health of environment, maintenance of biodiversity, and for assuring the quality of life, mainly for human when consumed.

WE255 Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Enhydris chinesis)

X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem; L. Wu, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences / State Key Laboratory of Organic Geochemistry; B. Mai, Guangzhou Institute of Geochemistry

Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenylchloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the offspring has been observed in oviparous species, i.e. fish, bird and frog. Few studies are focus on viviparous species, but ovoviviparous species have not yet been studied. It is known that watersnake (Enhydris chinesis) was ovoviviparous species. Their fertilized eggs develop into new individuals in the maternal body before producing offspring. The source of contaminants in watersnake eggs mainly derived from maternal tissues. In order to fully elucidate the deposition of contaminants in eggs, Firstly, the lipid-normalized concentration ratios of egg to muscle (EMR) were usually used to assess maternal transfer efficiency of contaminants in oviparous organisms. Secondly, due to relatively high lipid and weight of egg in watersnake, the ratios of contaminant burden in egg over the sum in muscle and egg (EMER) was used to evaluate the tissue distribution of contaminants in watersnake eggs. The values of EMR, and EMER were respectively 2.93 and 95% for PCBs and 0.35 and 68% for PBDEs. Meanwhile, DDTs, PCBs, PBB, HBB, PBB 153 and lower-brominated BDE congeners showed the ratios of EMR, and EMER higher than 1 and 88% (the lipid percentage of egg to egg plus muscle), respectively. The results indicated that these chemicals were readily transferred from muscle to egg or preferential accumulation in egg compared with muscle. Other chemicals, such as higher-brominated BDE congeners, DP, PBB209, and DBDE, showed ratios of EMR, and EMER lower than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. A multiple-linear relationship exists between EMER and log KW of the chemicals for the watersnake. For compounds with high hydrophobicity (log KW > 8), a negative relationship between EMER and log KW is observed (p < 0.01). This pattern was the same as that of other species such as fish, fish oil and trout. Few studies are focused on viviparous species, but ovoviviparous species have not yet been studied. It is known that watersnake (Enhydris chinesis) was ovoviviparous species.

WE256 Development of a Multi-compound Multi-matrix Method for Analysis of Halogenated Flame Retardants Comprising a Multi-step Cleanup and Use of GC-API-MS/MS and GC-EI-MS

F. Neugebauer, Eurosino GFA Lab Service GmbH / R&D; A. Dreyer, Eurosino GFA GmbH; N. Lohmann, Eurosino GFA Lab Service GmbH; J. Koschorreck, Umweltbundesamt

The ultra trace-analysis of halogenated flame retardants (HFR) leads more and more to the question of analyzing substances of actual or future relevance such as e.g. Dechlorane Plus and other dechloranes or novel brominated flame retardants together with legacy compounds as PBDEs. In order to address this issue, comprehensive analytical methods covering at the same time compound groups of different chemo-physical properties are more and more required, especially for monitoring purposes like analyses within environmental specimen banks. The presented method is validated for a broad range of different environmental matrices (spruce shoots as representatives for plant materials, bream fillet as representative for animal tissue, herring gull eggs as representatives for bird eggs and riverine surfaces, and fish as representative for organic matter rich in solids) and presently capable of analysing 21 alternative HFRs and 24 PBDEs. The analytes cover different chemical substance groups from Dechloran Plus and other dechloranes to brominated benzenes and alkyl benzenes, ethers and esters (TBA, ATE, BATE, PBT, PBE, HBz, DPTE, BEHTB, EHTBB, BTBPE, Dec602, Dec603, Dec604, DPMa, Cl10-antiDP, Cl11-antiDP, syn-antiDP, anti-DBP, DBDE). In this way, it gives an analytical basis for further extension towards other compounds. We will show details of different analytical aspects of the method, especially regarding different column chromatographic clean-up steps and use of modern analytical equipment as e.g. a GC-API-MS/MS-system, pointing out possibilities and limitations of such a broad scope of analytes.

Product benefits and positive outcomes: valuation and beyond (P)

WE257 A method to calculate carbon handprint

T.K. Paijola, S. Vatanen, VTT Technical Research Centre of Finland Ltd; K. Grönman, R. Soukka, Lappeenranta University of Technology

Environmental impacts are typically assessed by measuring and modelling the negative effects that products, services and companies cause to the environment. In practice this means evaluating the used resources and energy and the emissions caused. However, many companies do not causally link negative environmental impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pihkola et al. (2010). Only, we lack systematic methods to quantify and communicate these impacts that are also called handprints. This presentation proposes a concept to assess and communicate the carbon handprint of a product. The method is in line with life cycle assessment methods and is built on the principle that reducing one’s own footprint is not a handprint. Instead, the handprint comes through improvements caused in the performance of another actor. The most fundamental parts of defining the carbon handprint are to recognize the mechanisms of forming the handprint and to determine the baseline. The carbon handprint can be created via more efficient material or energy use, by replacing or avoiding unwanted materials, waste reduction or extended service life and reuse. Also carbon capture and storage is a way to contribute to carbon handprint. The paper demonstrates through case studies situations where different approach for the determination of the handprint is required. The quantification of the carbon handprint requires several carbon footprints calculated in order to find out if the new solution or product actually reduces the carbon footprint of another actor and life cycle approach. The footprints are used in a target actor using the baseline solution, the new solution and the target actor using the new solution.

WE258 Assessing regionalised Life Cycle Assessment (LCA) and economic values of ecosystem goods and services: Impacts of upstream natural land transformations on ecosystem quality

A. Ajayebi, University of Exeter / Renewable Energy

Setting up operational and spatially-explicit sustainability assessment models with practical levels of data requirement is becoming more essential as the trend of globalising economy is surging and accounting for impacts of human activities is becoming more complicated. Here we developed a model based on regionalisation of Life Cycle Assessment (LCA) that is capable of employing a holistic perspective while taking into account natural land transformations that are related to the life cycle processes. Furthermore, our model can interpret the impacts of land transformations on the ecosystem quality. Economic values of Ecosystem Services (ES) are used as an indicator and the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in the UK.

WE259 Recent advances in natural capital accounting


At the recent World Forum on Natural Capital (27-28 November 2017) a wide range of corporate, governments, scientists and businesses came together to discuss progress on accounting for Earth’s natural capital - the challenges, the innovations and the actions still needed. This poster will bring some personal reflections of the conference, including key findings from related recent literature, and elaborate on how scientists at SETAC Europe might engage with developments in natural capital accounting. Recent publications, such as “Can we stop depleting national capital?” (Cohen et al., 2017) highlight that global financial prosperity yet scientific research shows that some natural capital is in a poor state, and declining further. The report finds political and economic systems are unprepared for responding to the risk of natural capital degradation for three reasons: (i) natural capital is not being accurately measured or valued in the context of ecological tipping points; (ii) aggregate economic models are ill-suited for assessing ecosystem service value decreases due to upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream production industries. Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream production industries. Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream production industries.
including all natural capital could support greater prosperity if it were more appropriately valued and hence more efficiently used. The second is governance regimes based on scientifically informed political decisions should protect natural capital. Governance of natural capital stocks should be informed by biophysical limits, potential irreversibility, thresholds and risks to essential function. At the global level, the UN Sustainable Development Goals apply to all countries and provide a foundation for such a governance framework. We are all consumers and beneficiaries of natural capital, but it seems clear that SETAC members can also inform the debate. As environmental scientists we can contribute to developing an understanding of criticality – the tipping points for ecosystems, in particular where these relate to chemical pressures. There are opportunities to work with economists to ensure natural capital accounting and valuation is accurate and measurable, preferably quantitatively. One of the strongest themes was that we all need to improve our story telling across multiple disciplines and institutions.


The sustainability of hybrid-electric vehicles (HEVs) has been called into question (Bailey et al., 2017, Hickman, 2012, Publishers, 2008, Biello, 2016). With the recent onslaught of HEVs to the motor vehicle market, there is a need for the internalization of the costs—both environmental and economic—associated with one of its most valuable parts, the HEV motor. For this purpose, a screening Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) study has been carried out on the entire value chain of a dismantled HEV motor. The results of this study are analyzed quantitatively. The aim is to identify bottlenecks for such a quantitative analysis as well as to identify the hotspots from both an environmental and economic point of view. Furthermore, the results will serve as one of the important inputs in laying the foundation for the development of the sustainable hybrid-electric motor. This study computes total life cycle costs of a HEV motor. The analysis considered capital and operating costs in order to define the total vehicle cost of ownership over 10, 15, and 20 year life expectancies. The development of an integrated life cycle costing and life cycle analysis will allow any individual to evaluate properly tradeoffs of a hybrid-electric vehicle. References: Bailey, G., Mancheri, N. & Van Acker, K. 2017. Sustainability of Permanent Rare Earth Magnet Motors in (HEV Industry. Journal of Sustainable Metallurgy, 3, 611-626. Bailey, D. 2016. Electric Cars Are Not Necessarily Clean. Scientific American. Scientific American, a division of Nature America, Inc. N. HICKMAN, L. 2012. Are electric cars bad for the environment. The Guardian. IPI PUBLISHERS, I. 2008. Hybrid Electric Vehicles Not As Green As They Are Painted (Sysy Content Online). Inderscience Publishers/a/Available: www.scieducally.com/releases/2008/02/082070943314.htm [Accessed November 27 2017].

WE261 Developing a National Food Inventory to estimate the Carbon Footprint of the diet of an average Spanish. Future requirements and policy recommendations L. Batlle-Bayer, Universitat Pompeu Fabra UFPA / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change, Escola Superior de Comerç Internacional ESCI; P. Fullana, Universitat Pompeu Fabra UFPA / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Aldaco, Universidad de Cantabria / Department of Chemical and Biomolecular Engineering Dietary patterns have a significant impact on greenhouse gas (GHG) emissions, and diet choices can increase or reduce the Carbon Footprint (CFP) of consumers. Recently, more research has focused on estimating and comparing the CFP of different diets; however, high uncertainty is caused by the lack of reliable, available or representative data. The current study discusses this issue on data availability, and it results from our previous study on the CFP of the annual food consumption of an average Spanish citizen. To calculate the CFP of the average Spanish dietary pattern, a list of food categories with its representative food products was developed, and an extensive literature review was done in order to build up an inventory (inputs, outputs and emissions) per each food product. The system boundaries of this study are from cradle to consumer, and data for all life cycle stages (crop cultivation, farming systems, fisheries, industrial processing, marketing, distribution and consumer use) were gathered. Furthermore, food losses and food waste along the whole supply chain were also considered. While total annual emissions, about 1.4 Tn per Spanish citizen, were considered within the study, this resulted in the establishment of life cycle data at a national level. The proxies used to fill the data gaps were considered of good quality. However, there is a need to develop inventories for production of certain food products for which there is no inventory data available, as well as other life cycle stages, such as the wholesale & retail and the consumer phase. Furthermore, we suggest the inclusion of environmental data in food policy, for example, adding the CFP of food products and dietary patterns within the national dietary guidelines.

WE262 Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars P. Girardi, P.C. Brambilla, RSE Spa / SFE

The scope of this study is to compare the externalities of electric, gasoline and diesel motorizations of an average passenger car (aVW Golf) giving a complementary reading of the results of an LCA. Starting from the results of the NEEDS project, authors present a methodology taking into account: the years of the foreseen rate and the per capita GDP of considered countries. Moreover, the damage factor: production. Thus, producers are seeking to minimize the overall cost of their product generated throughout the life cycle. The private consumer, on the other hand, seeks to compare the different investment or purchase options by trying to integrate, in a holistic way, their present costs (acquisition prices and associated taxes) and future costs (use and end-of-life). Life Cycle Costing (LCC) is the typical tool to meet these objectives as it allows to analyze the cost structure of a specific object throughout its life cycle. Due to their convergent approach over life cycle, there are some complementarities between LCC and Life Cycle Assessment (LCA). A combined application of the two approaches could help economic actors and decision makers to find cost-effective solutions, while minimizing their life cycle external impacts. In order to combine both approaches requests to monetize the environmental impacts, to be able to aggregate them with the economic costs. Responding to SCORE LCA’s enquiring about LCC and its complementarity with LCA, the purpose of this study is to provide the keys to understand LCC, its concepts, its scope of use and its theoretical and conceptual limits. It also presents operational implementation elements such as: current methods of applying the LCC, means available for its implementation and possibilities of coupling it with LCA. In a first part, we present the theoretical bases and the state of LCC practice, i.e. definition and history, usefulness and reasons why the method is still not widely used. The second part presents the different types of LCC and the cost perimeters considered for each of them. The third part presents how to implement LCC, with detailed recommendations. The fourth part presents the possibilities of coupling LCC and LCA in practice by first showing the usefulness of such a combination, then by presenting the software that allows coupling methods. We conclude by identifying the necessary work to improve the LCC and LCC coupled with LCA.

WE264 Pizza: it is dangerously delicious! K. Stylianou, University of Michigan / School of Public Health / Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; V.L. Fulgoni III, Nutrition Impact, LLC; O. Jolliet, University of Michigan

The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributable to dietary risk factors. A challenge food Life Cycle Assessment (LCA) faces is that nutrition, a dominant impact pathway for health, is often neglected. At the same time, food LCA

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primarily focuses on single ingredient items while a large portion of modern diets is comprised of mixed dishes, a mixture of ingredients, which often remains unexplored. We propose a framework for evaluating mixed dishes in LCA that considers nutritional health impacts and benefits and demonstrate its application on pizza. We develop 14 marginal nutritional characterization factors (CFs) that cover major food groups and nutrients and allow the assessment of nutritional health effects in LCA. CFs are estimated by coupling age- and gender-adjusted outcome-specific incidence rates with risk ratios and severity factors from the Global Burden of Disease, measuring benefits (+) and impacts (-) in avoided µDALY/g. To evaluate the environmental impacts, we deconstruct pizza into “basic ingredients” using the USDA Standard Reference 28 database with a resolution of 3,200 single- and multi-ingredients that we further deconstruct. Ingredients are then linked to a life cycle inventory (LCI) datasets from the Ecoinvent v3.2, the World Food LCA Database v3.1, and the ESU World food database. We evaluate impacts using Impact World+. Nutritional CFs for food group and nutrient range between -8 (sodium) and 57 (omega-3 from seafood) avoided µDALY/g. Human health scores for pizzas range from -35 avoided µDALY/serving pizza with extra meat to 2 avoided µDALY/serving pizza with no cheese. For the environmental impact assessment, global warming estimates vary from 0.06 (pizza with no cheese) to 0.20 (pizza with extra meat) kg CO2 eq/serving, corresponding to -0.04 and -0.17 avoided µDALY/serving, respectively. When it comes to pizza, environmental emissions further enhance nutritional health impacts. Nutrition can dominate the human health and should be considered in food LCA. We have developed an approach bringing together environmental and nutritional health effects in a common currency that our proposed FU is to reconstruct protein sources based on the content of all food items and diets in LCA. Expanding this approach to various food items could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

WE265

The impact of supplemented amino acids in animal feed - a new Life Cycle Assessment approach using the Protein Quality Index as functional unit for comparing protein sources

A Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH

Proteins, which are made up of amino acids (AA), are essential for human health. Most of AA can be synthesized by the body but 8 of them are called “Essential Amino acids” (EAA) because they cannot be produced by human or animal and it is crucial to get them through food or feed intake. AA are also used as supplements in animal feed, providing the option to reduce the protein content of feed. Protein production has a major impact on the environment: it is responsible of ~14.5% of all food items and diets in LCA. Expanding this approach to various food items could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

WE266

The ISO/DIS 14008 standard: Monetary valuation of environmental impacts and related environmental aspects – Principles, requirements and guidelines - an overview

J. Serre, VERI; T. Bachmann, EIPER - European Institute for Energy Research / Urban systems group

Key words: monetary valuation, framework, standard, ISO 14008 The use of monetised environmental impacts and associated substances has substantially increased in the last couple of years. This trend is mirrored since 2016 by efforts at ISO level to develop standards on environmental costs and benefits. This contribution will present the result of the work achieved in ISO/TC 207/SC 1/WG 7, developing ISO 14008 whose current title is “Monetary valuation of environmental impacts and related environmental aspects — Principles, requirements and guidelines”. The work started in February 2016. After five WG meetings, ISO 14008 has reached the Draft International Standard (DIS) stage in fall 2017. The comments and ballot results of this DIS will be discussed during a WG 7 meeting in June 2018. Many organizations have experience in assessing environmental aspects and related environmental impacts resulting from their activities in physical units (e.g. tons of CO2 emitted or numbers of disability adjusted life years, DALYs). To further integrate this information into the decision making process, it is useful to take the time to define these environmental impacts and also of related environmental aspects. Monetary valuations enable comparisons and trade-offs between different environmental issues. The aim of this standard is to increase the awareness, understanding, comparability and transparency of monetary valuation of environmental impacts and related environmental aspects. Many methodological recommendations for recommendations are intended for persons assessing monetary values. Following these requirements and recommendations enables good practice. The requirements in the reporting clause assist the user of monetary values in assessing the quality of the monetary valuation study. The presentation will give an overview of the ISO/DIS 14008 document.

WE267

The safe and sustainable loops framework for assessing residual material flows


The circular economic system was developed to foster an industrial system that is restorative or regenerative by intention and design. An obstacle in the transition to such a system is that restoration of materials by reuse or recycling is subjected to safety legislation with an origin in the linear economy. In order to combat this obstacle, a shift is required from a purely safety based assessment to a more holistic assessment focused on sustainable development. Such a holistic assessment would allow stakeholders to make the absolute safety assessment, a requirement by law, with an assessment of the relative benefit that reuse of material flows have on all aspects of sustainability. However, assessing all aspects of sustainability is not practical for final decision making or feasible, considering the state of development of the tools, methods and data availability. Assessments of current recycling options are mainly focused on safety risks towards the environment and human health. Here we propose a first step in including environmental impacts or benefits related to closing material loops and increasing material value. This step is part of a bottom up approach to a more holistic methodology. It holds a novel framework (Safe and Sustainable Loops, SSL) aimed at assessing the safety as well as the sustainability changes of residual material flows within a clearly defined scope. In the Netherlands specific end of waste criteria can be applied to make the use of residual materials sustainable as a residual option under National or European waste policies. In this SSL framework we developed a method to identify and select from within this landscape of themes that are important in the choices regarding derogation of residual material flows for new applications. These themes are the building blocks of the framework, the modules. In theory, the framework itself is the backbone that connects these modules together. The current themes which are developed into modules are: Substances of very high concern (SVHCs), Pharmaceutical residues, Pesticides, Pathogens, Antimicrobial resistance, Circularity and Environmental Sustainability. These were selected for the first iteration of the framework because of their relevance for assessing risks and benefits of residual material flows during the past few years. The aim of this approach is to allow a level playing field using a generic framework with modules based on lessons learned from earlier cases.

WE268

Who is being served? Considering the values stakeholders wish to sustain in decision making

S.E. Atpiz, SEA Environmental Decisions Ltd

If we want our science to be part of the environmental decision process, we need to engage with stakeholders about what relevant values our science generates and how this science is relevant to and translated in terms of these values. This requires a consideration of as diverse a range of affected stakeholders as possible. Engaged subjects, due to a lack of resources, interest, or awareness, may not have their needs and values addressed unless a special effort is made to identify and consider them. One can view the concept of social equity as all-encompassing, under the premise that all impacts (positive and negative) of decisions can be seen as social impacts; and stakeholders must decide what services they envision for their land- and water-sca pes - what values they wish to sustain. In selecting indicators to represent stakeholder values, the challenge is to build a conceptual
framework which links measurable metrics of impact to value terms that resonate with the public, and reflect value statements made by the community. When the trade-offs are considered, it is important to consider the needs, demographics and vulnerabilities of a diverse population. Sustainability and ES concepts can and should be support environmental decision making; the application of threshold criteria ensures strong sustainability in which environmental considerations are not overlooked. Such considerations (which guides stakeholders to consider the extent to which they prioritize impacts to all (rather than just a narrow sub-set) of their values provides for a balanced public comment process, less subject to single- or narrow-issue lobbying. Identification of the risks and benefits of most interest to stakeholders also can support negotiation and optimization of alternatives under consideration, support collaborative design of more sustainable options and help inform the design of a long-term monitoring plan that addresses community values. The goal should be to envision a sustainable approach from the beginning of a project with collaborative input from a large group of stakeholders, supporting informed, transparent, and balanced decision making that protects services of importance to the community. Tools and approaches, and the path forward, will be discussed.

Salt of the earth - causes, consequences and management of salinization of surface freshwaters, groundwater and soils (P)

WE269 Effects of long-term exposure to increased salinity in the amphibian skin bacterium Erwinia toletana

A.C. Gabriel, University of Aveiro / Biology; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; S. Costa, Universidade de Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; I. Henriques, Universidade de Aveiro / Departamento de Biologia CESAM

Amphibians constitute the class of vertebrates with the highest proportion of endangered species; chemical contamination being a main factor for its populations and species decline. The skin bacterial community of amphibians may help them to cope with such chemical contamination. If skin bacteria may increase its tolerance to chemicals, then they could be used for bioaugmentation in amphibians to help them cope with contamination. This work aimed at assess if an amphibian skin bacterium could increase its tolerance to NaCl after long-term exposure to low levels of salinity. Erwinia toletana, isolated from the skin of Pelophylax perezi, was selected as the model species. Clonal populations of this bacterium (5 replicates) were exposed for 46 days to LB medium (Et-LB) or to the effective concentration of NaCl causing 10% of growth inhibition (Et- NaCl; 18g/L). To assess the capacity of recovery from long-term exposure to NaCl, after the 46 d period. Et-NaCl was transferred to LB medium and cultured for a period of 16 d (Et-R). The Et isolate also continued to be cultured in LB medium for further 16 d. The tolerance of ancestral and evolved populations to NaCl was assessed by exposing them to 6 NaCl concentrations (5, 10, 15, 20, 25 and 35 g/L) plus a control (LB medium). Effects of NaCl on bacteria growth and metabolic mechanisms (as degradation of carbon compounds) was monitored. Genotypic alterations were assessed using a PCR-based molecular typing method (BOX-PCR). Results of growth showed that long-term exposure to NaCl slightly increased the tolerance of E. toletana to this salt, EtCs for growth were: 22.5g/L (8.64-36.4) for Et-LB; 30.3g/L (23.2-37.4) for Et-NaCl, and 26.1g/L (19.3-32.9) for Et-R. Though, as confidence limits overlapped, tolerance increase was not considered significant. Furthermore, differences in metabolic processes were observed between Et-LB and Et-NaCl, suggesting the use of different carbon sources. This could be associated with the activation of detoxification mechanisms or energetic demanding mechanisms to cope with osmotic stress. Genotypic alterations were not observed, indicating that E. toletana increased tolerance to NaCl could be due to membrane plasticity mechanisms to cope with osmotic stress. The tendency shown by E. toletana to acquire increased tolerance to low levels of salinity could constitute a promising bioaugmentation tool in amphibian’s skin, aiming the improvement of these organisms tolerance to chemicals.

WE270 Impacts of agriculture brackish effluents in saline ecosystems: when the low salinity cannot be an advantage but an impact

J. Alvarado-Rueda, University of Lethbridge / Superficie Ingeniería Agroénica. Universidad Politécnica de Cartagena / Cartagena y Tecnología Agraria. F. Jiménez-Cárceles, BIOCYMA, Consulting in Environment and Quality, S.L. Murcia, Spain.; M. González-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM

Salinity is one of the most important factors of soil and water degradation worldwide. Anthropogenic salinization due to the use of low quality water and/or over-fertilization leads the existence of saline effluents that degrade water quality and constrain plant growth and crop production. However, in saline wetlands salinity is not undesirable, but a proxy parameter to maintain the singularity of the ecosystem. In these environments the existence of a diversity of habitats is closely related to gradients of soil salinity and moisture, with extremely saline brackish sites, wetter sites and drier sites. While agricultural saline effluents may salinize normal soils, they can degrade saline wetlands by decreasing the native soil salinity. This work reports changes in ecosystem structure and diversity in a saline wetland adjacent to the Mar Menor saline lagoon (SE Spain). Species cover, soil salinity, and the groundwater level were monitored in two 2-years periods with a difference of 13 years between them. The results indicated an elevation of the water table throughout the 13-year period, which was attributable to brackish water flows from areas with intense agriculture. The water level increased of flooding periods, a decrease of soil water content in the more saline sites and water levels increased in the least saline ones. Following these changes, damages in protected habitats were observed, due to the proliferation and increase of biomass of several species. Sarcocornia fruticosa, P. australis and Juncus maritimus strongly expanded at the wettest sites, which led to the disappearance of the original zonation pattern and the homogenization of the ecosystem. Bare areas, necessary for nesting and feeding of several bird species, disappeared. According to the results obtained, a decrease of soil and water salinity was one of the main factors contributing to the degradation of the saline wetland leading to an exacerbated growth of some species and a decrease of habitat diversity. In this case, the low salinity of the effluents reaching the wetland was a problem, not an advantage.

WE271 Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?

B.J. Kefford, J. Reich, J. Bray, University of Canberra / Institute for Applied Ecology

The effect chemicals on populations and communities have long been noted to vary between different studies although the mechanism(s) for this variation is unclear. Research has examined variability associated with chemical and physical environments (e.g. bioavailability, co-occurring contaminants) and ecotoxicological and physiological (e.g. temporal and spatial variability in species' sensitivity). Less consideration has been given to ecological mechanisms including those mediated via indirect effects such as competition and predation. For example, a given population of a species may be able to persist in the presence of a particular level of contamination, but this persistence may be dependent on competition and predator prey interactions, and the relative fitness of these taxa at that level of contamination. Here we report the results of a mesocosm experiment that examined the effects of biotic interactions on salinity effects. We examined effects across a broad salinity gradient using 'sensitive' communities collected from a low salinity site (~80 μS/cm) and 'tolerant' communities (collected from a high salinity site ~1600 μS/cm). This was examined using a mesocosm experiment consisting of 32 independent re-circulating 1000 L mesocosms. Controls (100 μS/cm) and salinity treatments (500, 1000, 2500 and 5000 μS/cm) these were replicated 4 fold and were crossed in an orthogonal design with the source biota (stream macroinvertebrates and microbe) either from: (1) a low salinity site only or (2) both low and high salinity sites. The experiment is based on the logic that if salinity increases at a site, organisms have the potential to migrate from higher salinity sites within the same region. Thus the organisms from the (previously) low salinity site would have to be able to tolerate both the increase in salinity and ecological interactions with organisms from higher salinity sites. We observed differing effects of salinity on the macroinvertebrate community from the low salinity site depending whether these biota were co-inhabiting with biota from a high salinity site. Such context dependent toxicity deserves greater consideration in studies of the effects of chemicals on populations and communities.

WE272 Challenges in developing a water quality guideline for water hardness

S. Bogart, University of Lethbridge / Department of Biological Sciences; E. Stock, University of Lethbridge; A. Manek, University of Saskatchewan; A. Tillmanns, C. Meays, British Columbia Ministry of Environment & Climate Change Strategy; G.G. Pyle, University of Lethbridge / Biological Sciences

Increases in salinity, or the total ionic content, of water can be toxic to freshwater species, as can shifts in the balance of major ions (Ca$^{2+}$, Mg$^{2+}$, Na$^+$, K$^+$, HCO$_3^-$, SO$_3^-$, Cl$^-$), or increases in the Ca$^{2+}$ and Mg$^{2+}$ content of water alone (i.e. water hardness). Although anthropogenic salinization of freshwater is increasing, virtually no water quality guidelines (WQG) exist for regulating these individual ions or their mixtures. WQG are generally used to prevent potentially toxic concentrations via effluent, produced waters, and saline run-off from various human activities, e.g. coal mining, oil and gas extraction, the use of Ca- and Mg-based road de-icers, and agriculture. Thus, developing a water hardness based WQG for the protection of aquatic life is warranted. Using Canadian protocols for WQG development, we attempted to derive a WQG for water hardness. Relevant data were collected for various freshwater ecosystems, but the inclusion in the WQG, however, current literature offered several challenges and major data gaps that hindered WQG derivation. Moreover, the background variation of water hardness throughout an examplary regulatory region of interest also did not support WQG development using traditional methods. These challenges and limitations will be discussed in the context of similar regulations from other jurisdictions, the need to consider additional, practical limitations of regulating water hardness, or major ions in general, recommendations for improved data consistency, and potential regulatory options.

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WE273
Prioritization of water quality stressors according to their relative impact on ecological quality of rivers using large-scale field data: salinity first?
E. Berger, Senckenberg Gesellschaft / Department Quantitative Landscape Ecology; R. Schäfer, University Koblenz-Landau; P. Haase, A. Sundermann, Senckenberg
The political aim of achieving good ecological quality of all European water bodies requires knowledge on how to prioritize stressors and human pressures for management based on their relative impact. A challenge thereby is the frequent co-occurrence of multiple stressors. We applied eco-epidemiological approaches to large scale monitoring data from Saxony, Germany, to investigate the relative contribution of different water quality and land-use gradients to ecological change. Two approaches were applied: First, water quality gradients (e.g. oxygen, conductivity, phosphorus and micropollutants) and land-use gradients (e.g. % arable and urban catchment land cover, position of wastewater treatment plants) were used as predictor variables in multiple linear regression analysis and hierarchical partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GSI, SPEAR %) as response variables. Secondly, individual taxa responses to stress with respect to different water quality gradients (including also major ions such as potassium, sodium, chloride etc.) were assessed using Threshold Taxa Indicator Analysis (TITAN). The method is based on change point and indicator species analysis and allows the identification of ecological change points that may be used to derive environmental quality criteria. Both regression analysis and TITAN results indicate a high impact of oxygen and salinity, which were associated with both land and land use variables and stand standard UQA water quality criteria. Although observed associations may not be direct causes of ecological impairment, it may be worthwhile to implement legally binding quality standards for these variables. Of the 324 analyzed taxa 23% had change points far below the German orientation value for chloride (200 mg/L) that should not be exceeded to achieve good ecological status according to the water framework directive. Thus, lowering of chloride salinity and associated ions should be considered to protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

WE274
Estimating protective potassium concentrations for fresh water mussels, a taxon of global conservation concern
T. Augspurger, U.S. Fish and Wildlife Service / Ecological Services
Globally, there are about 620 species of freshwater mussels (Family Unionidae), and IUCN lists 28 species as extinct and 106 as endangered or critically endangered. Mussels are among the most sensitive freshwater water organisms to toxicity from chloride and potassium, and the environmental relevance of these is increasing with sea level rise and brine discharges. Average potassium concentrations in relatively unpolluted streams of North Carolina (USA) range from 0.2 to 2 mg/L. An industrial effluent with potassium averaging 304 mg/L and proposed for discharge to a stream with endangered mussels necessitated derivation of protective potassium limits (both above and below current standard limits) as water quality criteria for potassium. From the literature, we compiled potassium 96-h EC50s (with endpoints of lethality or immobilization) for mussels and retained those with > 90% control survival, measured test chemical concentrations, and acceptable test water quality. Five EC50s ranged from 31 to 48 mg/L at a water hardness of 100 mg/L as CaCO3, and we applied the North Carolina guidance of 3 mg/L and the German guidance of 10 mg/L as a potassium concentration threshold to derive acute toxicity. We adjusted the 10 mg/L acute limit to a water hardness of 18 mg/L which is the 5th percentile of the proposed receiving stream (protective most of the time because potassium is less toxic as hardness increases). The hardness-adjusted acute water quality guideline of 7 mg/L potassium was recommended as an instantaneous concentration not to be exceeded. Chronic toxicity data for potassium and mussels were available for two studies from 28 to 300-d. Because mussels can live for decades, we used the 300-d test. The geometric mean of the test NOEC (1 mg/L) and LOEC (7 mg/L) yield a chronic value of 2.6 mg/L potassium which was recommended as a monthly average guideline not to be exceeded more than once every three years. We used 32 years of receiving stream flow data to derive estimates of instream mussels' exposure to salinization. The study highlights uncertainties in guideline derivation and discuss recommendations for quarterly mussel toxicity tests, instream monitoring, and research to narrow uncertainties. There are several means by which stream-specific and mussel-specific potassium guidelines could be derived. This method tracks North Carolina water quality standards and definitions and is reasonable with available data.

WE275
LIFE LAGOON REFRESH - Coastal lagoon habitat (1150*) and species recovery by restoring the salt gradient increasing fresh water input.
Management measures in the northern Venice Lagoon (NE, Italy)
F. Cacciatore, ISPRA-Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; A. Bonometto, A. Feola, E. Ponis, ISPRA Institute for Environmental Protection and Research; A. Sfriso, University Ca Foscari of Venice; B. Matticchio, IPROS; M. Lizer, Regione del Veneto; V. Volpe, Provveditorato OO. PP. Veneto, Trentino Alto Adige e Friuli Venezia Giulia; M. Ferla, R. Boscolo Brusà, ISPRA - Institute for Environmental Protection and Research
The northern Venice Lagoon (SCI IT3250031) holds several Annex I-listed habitats of the Habitats Directive, such as the habitat type 1150* (Coastal lagoons). Recent monitoring activities showed that conservation status of the habitat 1150* is improving within SCI IT3250031, but it is still unfavourable in the inner landward area where the lagoon is too close to lack of ecosystem services, favouring self-regulation processes, between lagoon and mainland. In the past, the protect area was occupied by reedbeds in large amounts, now significantly reeded due to increasing of lagoon water salinity, caused by historical human activities (e.g. diversion of rivers with reduction of freshwater supply, inlet and channel excavation). With reduction or disappearance of reedbeds, their contribution to ecosystem services, like supporting numerous biological communities and species, are minimised. The LIFE LAGOON REFRESH project, started on Sept 2017, foresees the restoration of favourable conservation status of habitat 1150* in the northern Venice Lagoon and the recreation of favourable habitats for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the Sile river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between lagoon and mainland); restoration of intertidal morphology through the implementation of structures properly arranged to slow down the freshwater dispersion and to favour reef development; planting of Phragmites australis to accelerate the development of the reedbeds; transplantation of small dumps of seagrass species of the habitat 1150*, suitable to accelerate the recolonization by aquatic plants of low-salinity environments. The project aims to exploit the serially diluted effluents and synthetic solutions (e.g. NaCl CaCO3) of similar salinities. The tolerance of Festuca rubra L. (fescue) and Trifolium pratense L. (clover) were investigated for 5 weeks under hydromonic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared the serially diluted effluents and synthetic solutions (e.g. NaCl CaCO3) of similar salinities. There were different growth responses to the wastewater and saline solutions among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. The restoration of salinity gradients will also contribute to increase biodiversity in the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE276
Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity
P. Srikhumsuk, University of Strathclyde / Department of Civil & Environmental Engineering; C. Knapp, J. Renshaw, University of Strathclyde / Civil and Environmental Engineering
Effluents (produced and flow-back waters) from the petroleum industry have been between 10 and 50% brine solution and associated toxicity to the environment, particularly regarding to chemical composition and salinity. The purpose of this study was to investigate whether their toxicity is any greater than exposure to solutions of similar salinity. The tolerance of Festuca rubra L. (fescue) and Trifolium pratense L. (clover) were investigated for 5 weeks under hydromonic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared the serially diluted effluents and synthetic solutions (e.g. NaCl CaCO3) of similar salinities. There were different growth responses to the wastewater and saline solutions among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. The restoration of salinity gradients will also contribute to increase biodiversity in the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE277
Contribution to the salinization risk assessment, under drought conditions, in the Alqueva irrigation area (South Portugal)
In Mediterranean regions, climate changes have enlarged water limitation for crops, leading to an increased demand for irrigation water. During the hydrological years of 2015 to 2017, Portugal, and the Alqueva basin, situated in the heart of the country, throughout almost the entire mainland territory reaching a severe drought level. Under water scarcity conditions and high atmosphere evaporative demand, the risk of land salinization is one of the major threats to the sustainability of irrigated agriculture. Therefore, it is very important to assess the quality of irrigation water and the risks of salinity for crop production, in order to adopt appropriate management practices in irrigated areas. This study is focused on the salinity risks for the production of the most representative crops grown in the Alqueva irrigation area. This is a large irrigation scheme with a total area of 120 000 ha centered in the Alqueva reservoir. For the purpose of the study, a chemical assessment of some of the irrigation water samples from the irrigation area was made using a spectrophotometric method. Among the 18 studied variables, the calcium and magnesium concentrations were the most critical, exceeding the water quality guidelines in 81% of analyzed samples. These results show the need to assess the salinization risk in the Alqueva basin, in order to implement adequate management practices in irrigated areas.
major inorganic ions (Na⁺, Ca²⁺, Mg²⁺, K⁺, SO₄²⁻, and Cl⁻), pH and electric conductivity (ECa), was conducted throughout 2017, on water samples collected on four platforms sited in the reservoir. Water quality for irrigation was evaluated considering both the Portuguese regulations and the FAO guidelines. Sodium adsorption ratio (SAR) and soil salinity (ECe) were estimated, in order to assess potential sodium-related soil permeability and crustling problems, as well as, potential yield reductions in the most important crops of the Alqueva perimeter. Higher ion concentration in water samples and water salinity may affect the fitness of the most dominant zooplankton species of the southern part of the North Sea. Since responses to environmental stress are genome-driven, a genetic study on the physiological responses to thermal stress can provide an increased mechanistic understanding and help predict potential responses to climate change in this copepod species. Therefore, we sequenced the whole transcriptome (using RNA-seq sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will provide us with new insights on how exposure to increased sea water temperatures may affect the fitness of the most dominant zooplankton species of the southern part of the North Sea.

**Systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (P)**

**WE279 Investigating wildlife diets using high-tech DNA sequencing**

J. Ludwigs, Rifcon GmbH; I. Katzschner, Rifcon GmbH Goldbeckstr Hirschengr Germany; G. Weyman, ADAMA; A. Winkler, J. Kalinowski, Center for Biotechnology (CeBiTec) Universität Bielefeld

In wildlife risk assessments according to EFSA (2009), the ingested diet is one of the core factors to define exposure, using default diet compositions in the first tier risk assessment. The ‘spatial’ PD factor (composition) is used as proportion of diet item masses in the standard refinement parameters which intend to add realism to higher tier risk assessments. Publically available dietary data are often used to refine PD in wildlife risk assessments; however, such data are often variable and/or not representative for the specific risk assessment scenario. Besides such literature data, specifically registration-relevant PD field studies can be conducted. PD values gathered from such studies can be used as dietary samples for feeding experiments, for example, in these studies samples (or parts thereof), are investigated visually by microscope and food items are identified based on comparison with comprehensive reference data libraries and collections of potential diet items. For plant material, the results are mainly presented on a fairly basic taxonomic level and are often related to wildlife risk assessment defined diet fractions which have different default residue levels (e.g. dicotyledonous plants or monocotyledonous plants only). However, this is rather time-consuming and imprecise. Recently, DNA sequencing techniques are increasingly applied for diet composition analyses in ecological science. We initiated an approach using ‘next-generation’ DNA amplicon sequencing to quantitatively assess the diet composition of wild herbivorous mammals, taken from faeces samples collected on arable fields. Data on the relative abundance of each plant species were derived by enrichment and sequencing of a specific DNA region (ITS2 region of the ribosomal DNA) and by comparison to comprehensive plant species DNA databases. The approach has proved to be very useful on identification of relative abundances of plant species from faecal samples. This new genomics approach, its needs and limitations for refined risk assessment will be presented and discussed.

**WE280 Design of a Real-Time PCR array to analyze the gene expression in Physella acuta (Gastropoda) in chemical stress and starvation**

M. Novo, J. Martinez-Guitarte, UNED / Fisica Matematica y de Fluidos Molecular endpoints are increasingly used under laboratory conditions to assess ecotoxicity tests. While vertebrate species are usually well-known, there is a lack of information on invertebrates. The study of the latter is complex since their body shape, behavior, and ecology are very diverse, and great differences can be found even within the same animal group. In order to improve our knowledge in putative molecular endpoints and to evaluate some genes as biomarkers, a Real-Time PCR array was designed for Physella acuta. This species of freshwater snail is used in environmental toxicology studies and it has been proposed as an adequate species for toxicity tests because of its sensitivity to different toxicants and ease of culture. A transcriptome for this species was assembled, by sequencing cDNA libraries from individuals of different developmental stages and exposed to different toxicants. Comparison with database allowed the identification of genes involved in pathways related to toxicity and selected 42 of these genes and six genes used as reference to design an array for Real-Time PCR analysis. Stress response, detoxification mechanisms, endocrine system, or epigenetics were some of the pathways analyzed in the array. In order to validate the toxicological and ecological interest of this approach, individuals were treated with an antibiotic, tetracycline, for seven days or were left starving for 7 and 10 days. The results obtained for these experiments are presented, showing the interest of designing specific arrays to perform more detailed analysis of molecular endpoints that can be related with toxicant mode of action and stress situation. We hope that the methodology presented here can serve as an example for the study of other species in order to improve our knowledge of their biology. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CMT2015-64913-R.

**WE281**

**Evaluating of temperature of the transcriptome of the marine copepod Temora longicornis**

J. Sennour, Ghent University (UGent) / Animal Sciences and Aquatic Ecology; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecol; R. Janssen, Ghent University / Applied Ecology and Environmental Biology; K. De Schampaert, Ghent University (UGent) / Applied Ecology and Environmental Biology

Over the past decades, the world's oceans and seas have been influenced by several human induced impacts, including climate change. In the North Sea region, the average sea surface temperature of the water has already risen with 1-2 °C over a time span of 20 years and is likely to increase further. Understanding the impacts of this changing environmental condition in zooplankton communities is crucial, as alterations in the zooplankton communities can affect entire marine ecosystems. Here, we focus on the potential effects of an increase in temperature on the calanoid copepod species, Temora longicornis, the dominant zooplankton species of the southern part of the North Sea. Since responses to environmental stress are genome-driven, a genetic study on the physiological responses to thermal stress can provide an increased mechanistic understanding and help predict potential responses to climate change in this copepod species. Therefore, we sequenced the whole transcriptome (using RNA-seq sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will provide us with new insights on how exposure to increased sea water temperatures may affect the fitness of the most dominant zooplankton species of the southern part of the North Sea.

**WE282**

**A conditional approach to modern endpoints - quantitative assessment of stress gene expression response to a range of copper concentrations in the freshwater mussel Anodonta anatina**

G.M. Ekelund Uge, Lund University / Biology; A. Jonsson, University of Skövde / Department of Bioscience; O. Berglund, Lund University / Dept of Biology

In the field of ecotoxicology, modern transcriptionomics technologies have the potential to improve and complement current toxicity assessment methods and biomonitoring protocols. Early warnings of general stress and specific toxic modes of action could in theory be used as biomarkers of pollutant exposure or adverse effects. However, necessary base level understanding is currently lacking considering how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more descriptive methods. We chose the freshwater mussel Anodonta anatina as our model organism. Being a stationary filter feeder, it shows promise for use in exposure studies under both laboratory and field conditions. Furthermore, it is the most abundant freshwater mussel species in Sweden, and occurs in freshwater ecosystems over most of Europe. For the present study, mussels were collected locally in Vänne å (southern Sweden), on a location free from point source pollution. After two weeks of acclimatization to laboratory conditions, mussels were exposed for 96 h to one of three copper treatments (nominal concentrations of 1,10 and 100 µg Cu²⁺, or a control treatment (n= 5 per treatment). Using RT-qPCR, relative expression of a selection of general stress genes will be quantified in extracted digestive gland and gill tissue. Preliminary data will be presented, testing the hypotheses that the amplitude (fold-change) of relative expression differs (i) between the different stress genes, and (ii) between the different stress genes in the same treatment. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.

**WE283 Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation**

T.F. Simoes, S.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Renaud, CEFBAI / Laboratory for Aquatic Functional Ecology; J. Sousa, University of Coimbra / Department of Life Sciences; J. Rönbke, ECT Oekotoxikologie GmbH; D. Roelofs, Vrije Universiteit / Department of Ecological Science; N. van Straalen, Centre for Functional Ecology; J. Sousa, University of Coimbra / Department of Life Sciences, University of Coimbra

We tested the potential of using a contamination assessment tool using a fungicide-based formulation and the following species: Folsomia candida. The potential phytotoxic and antigenotoxic effects of the fungicide were tested in the most abundant freshwater mussel species in Sweden, and occurs in freshwater ecosystems over most of Europe. For the present study, mussels were collected locally in Vänne å (southern Sweden), on a location free from point source pollution. After two weeks of acclimatization to laboratory conditions, mussels were exposed for 96 h to one of three copper treatments (nominal concentrations of 1,10 and 100 µg Cu²⁺, or a control treatment (n= 5 per treatment). Using RT-qPCR, relative expression of a selection of general stress genes will be quantified in extracted digestive gland and gill tissue. Preliminary data will be presented, testing the hypotheses that the amplitude (fold-change) of relative expression differs (i) between the different stress genes, and (ii) between the different stress genes in the same treatment. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.
experiments with a transcriptomics approach are essential to unravel modes of action, spinosad and indoxacarb.

- WE248

Proteome response of Chironomus riparius under exposure to the neurotoxic insecticides Spinosad and Indoxacarb

H. Pestana, CESAM/UFCA; F. Baptista, Universidade Federal de Santa Catarina; M. Barbosa Xavier, Universidade Federal de Santa Catarina / Biochemistry; C. Elena Baptista, Universidade Federal de Santa Catarina / Biochemistry Department; I. Baptista, Universidade Federal de Santa Catarina

- WE286

Assessing Cu impacts on freshwater diatoms: biochemical and metabolomic responses of Tabellaria flocculosa (Roth) Kützing

S.I. Gonçalves, Universidade de Aveiro / Biology; M. Kahler, SLU Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; S. Picart, University of Biology and GeoBioTec; E. Figueira, University of Aveiro / Biology; M. Kahlert, SLU Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; A. Mega, University of Aveiro / Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

The development of quantitative methodologies in proteomics opened new doors for their potential applications within environmental sciences. Since proteins are the functional units of cells, the proteome of an organism at a given time and at a given condition reflects its current state. In this sense, any protein profile changes in response to toxicants may reveal their molecular targets and/or specific stress-response mechanisms, and thus be used as potential early warning biomarkers of toxic exposure. In this study, the potential of proteome changes as an early warning indicator for pesticide exposure in Chironomus riparius (Meigen) was evaluated using as model compounds two neurotoxic pesticides with distinct modes of action, spinoasad and indoxacarb. Chironomus riparius third-instar larvae were exposed to three concentrations of each pesticide and iTRAQ methodology was performed to relatively quantify protein expression changes between exposed and non-exposed organisms. As expected, the pesticides exposure triggered different responses at the proteome level. Changes caused by spinoasad were more noticeable than for indoxacarb exposure. Our results revealed a general decrease in the expression of globin proteins with the increase of spinoasad concentration. Additionally, for spinoasad, a significant decrease in the expression of an actin and a cuticle protein were also observed. Moreover, correlations between proteomics data and previous studies on biochemical biomarkers of both spinoasad and indoxacarb were possible. Our results suggest that protein profile changes have the potential to be used as early warning biomarkers of pesticide exposure, providing an interpretation of molecular pathways of toxicity behind the organismal response, therefore supporting the risk assessment of pollutants. This work contributes to the growing knowledge of sub-threshold effects of pesticides in invertebrates and their molecular targets.

- WE287

Non-targeted approach to identify metabolic perturbations in gilt-head bream liver and brain exposed to benzophenone-3

H. Ziarraga, L. Mijangos, University of the Basque Country UPV/EHU / Department of Analytical Chemistry; S. Picart, Polytechnic university of Catalonia UPC / ESAII department; A. Usobiaga, A. Prieto, N. Etxebarria, M. Oliviares, O. Zuloaga, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dept Analytical Chemistry

Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation. The extensive use of BP-3 has led to its ubiquitous occurrence in the aquatic environment, causing an ecotoxicological risk to biota. Although some studies reported adverse effects on both BP-3 and BP-3a, further research needs to be done in order to assess its molecular and physiological effects, and modes of action. Therefore, in the present work, we investigated metabolic perturbations in juvenile gilt-head bream (Sparus aurata) exposed over 14 days via the water to BP-3 (50 mg/L). Liver and brain were collected prior to dosing and on exposure days 2, 4, 7 and 14 from control (n=10) and exposed (n=10) animals. Samples were flash frozen and then stored at -80ºC until analysis. Methanol:chloroform (80:20, v/v) mixture was used for non-selective extraction of fish tissues and subsequent non-target analysis was performed by means of UHPLC-Orbitrap MS in positive and negative modes with both C18 and HILIC separation. Metabolites were identified using Compound Discoverer (Thermo) interfaced to MS/MS and the statistical data treatment was carried out with R software. Mortality was not observed during the experiment, and no statistical changes in fish weight, fish length, condition factor and hepatic somatic index were observed regardless of tank or dosing period. First of all, using sequence quality control samples, data had to be corrected to remove the effect of injection order. On the other hand, since some metabolites were significantly changed between different control and exposed (n=10) samples, samples were flash frozen and then stored at -80ºC until analysis. Methanol:chloroform (80:20, v/v) mixture was used for non-selective extraction of fish tissues and subsequent non-target analysis was performed by means of UHPLC-Orbitrap MS in positive and negative modes with both C18 and HILIC separation. Metabolites were identified using Compound Discoverer (Thermo) interfaced to MS/MS and the statistical data treatment was carried out with R software. Mortality was not observed during the experiment, and no statistical changes in fish weight, fish length, condition factor and hepatic somatic index were observed regardless of tank or dosing period. First of all, using sequence quality control samples, data had to be corrected to remove the effect of injection order. On the other hand, since some metabolites were significantly changed between different control and exposed samples, samples were flash frozen and then stored at -80ºC until analysis.

- WE288

EFLUENTS FROM PULP AND PAPER MILLS PROMOTE METABOLIC ALTERATIONS IN LIVER AND GONADS OF FISH

M. Barbosa Xavier, Universidade Federal de Santa Catarina / Biochemistry; C.H. Soares, Universidade Federal de Santa Catarina / Biochemistry Department; I. Baptista, Universidade Federal de Santa Catarina

Effluents from pulp and paper mills are internationally recognized as containing toxic substances with properties to alter the reproductive capacity of fish. The objective of this study was to evaluate the metabolic modifications (using metabolomics tools) of fish gonads and liver (Danio rerio) exposed to effluent from the pulp and paper industry, with an emphasis of embryos and eggs representing the fish. The effluent was diluted by a factor of 1/25. The fish (10 males and females) were exposed to the effluent, and males and females were kept separated for 7 days at 28°C and a light / dark cycle of 12/12 in 3.5 L tanks. After the pre-exposure period, males and females were mated (1 couple per Becker containing a net at the bottom) and monitored for 6 days with daily water/pollutant renewal and once a day. The eggs were collected and placed on plates containing the test agent, kept protected from light. The fish were sacrificed for liver and gonads removal, from which a homogenate was prepared. Then, extraction was performed with chloroform/ methanol/water (3: 2: 1). The extract considered to be contaminated (0.3 µg Cu/L) and toxicity increased with Cu concentration. Strategies to cope with Cu varied with the level of Cu stress. Under Cu impact, the metabolome of T. flocculosa changed significantly, especially at high concentrations (6 and 10 µg Cu/L). Cu toxicity was counteracted by increasing extracellular immobilization (EPS, frustulin), antioxidant (SOD, CAT) and detoxifying (GSTs) enzymes activity and low molecular weight antioxidants (GSH). These mechanisms were modulated by a higher energy production (IETS activity, use of sugars and catabolism of lipids). At the highest Cu concentration (10 µg/L), these metabolic processes were specially enhanced in an attempt to restrain the oxidative stress generated by high intracellular Cu concentrations. However, these mechanisms were not able to fully protect cells, and damage in membranes and proteins occurred. Moreover, the decrease of hydroxylamine and unsaturated FA and the increase of saturated FA, 2-palmitoylglycerol, glycerol and diterpenon compounds should be tested as new specific markers of Cu toxicity in future studies. This information can support the prediction of diatom behaviour in different Cu contamination levels, including highly impacted environments, such as mining scenarios, and may assist in environmental risk assessment policies.

https://www.dropbox.com/s/8b1jsezdiqx3rmw/graph%20abs%20Compuer.tif?dl=0
obtained was prepared for gas chromatography. For the exposed fish, there was a significant reduction in egg production, 65%. A high percentage of the eggs presented dark staining, which are not viable. Chromatography analysis revealed significant changes in the amino acid, sterol and fatty acid profiles in both tissues, liver and gonads. The results showed a strong impact on the metabolism, egg production and embryo development for the studied fish, which point to the alteration of their reproductive capacity.

WE289
Developing biomarkers of sewage effluent exposure in the freshwater amphipod Gammarus fossarum
D.R. Caputo, University of Portsmouth / Biological Sciences; T. Werner, Ecotox Company Ltd.; D.J. Rice, Department of Anatomy Physiology and Cell Biology; S. Robson, University of Portsmouth / School of Pharmacy & Biomedical Science; A. Ford, University of Portsmouth / Biological Sciences

Pesticides, pharmaceuticals, industrial chemicals and complexing agents coming from sewage effluents, can be detected in the aquatic environment in very low concentrations. They are able to impact ecological communities, causing biological alterations in many species. Although biomarkers in vertebrates have long been applied, attempts to monitor dysfunctions in invertebrates using orthologous genes have produced inconsistent results. Gammarsids are a group of amphipods that have been shown as very sensitive to pollution, having been used in various studies for toxicity evaluation of river waters through exposure to many different chemicals. However, to date most studies have been focusing on specific life-cycle stages, potentially missing complex interactions among expressed genes not involved in development. The aim of this study is to provide a set of new transcriptomic and metabolomic markers in Gammarus fossarum. After validations in further studies, the new biomarkers found in this project could be used to evaluate the state of aquatic ecological niches and the efficiency of wastewater treatment plants (WWTPs). Amphipods were sampled from a freshwater stream located in Elgg, Switzerland in September 2017, using standard kick-net method. This stream flows through an industrial WWTP, steadily exposing the whole fauna and flora to a range of pollutants. Sampling was performed 50 m downstream of the WWTP and 50 m upstream, as reference site. Five biological replicates and five technical replicates for both males and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A subsample of amphipods was collected for metabolomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential intersexuality phenotypes. The RNA samples have been sequenced by Illumina Genome Analyzer. A differential expression analysis will be conducted to identify significantly different genes between upstream and downstream populations. Subsequently, a comparison between the transcriptomic and metabolomic datasets will be carried out, allowing a better understanding of the biological functions impaired after amphipods wastewater exposure. A biological pathway analysis will be also performed on the differentially expressed genes, allowing a correlation of the impaired molecular pathways after chronic exposure to water pollutants with the chemical mixture found in the wastewater effluent.

WE290
Optimising the algal toxicity test towards generation of multi-omics data and adverse outcome pathway discovery
S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessments (CEA) / Ecotoxicology; J. Zhou, S. He, University of Birmingham / School of Life Sciences; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences

The adverse outcome pathway (AOP) concept represents a framework to organize mechanistic understanding of toxicological interactions by causally linking critical molecular key events (KEs) to apical endpoints relevant for chemical risk assessment. Currently, only few methodologies can be considered for an accurate and reliable discovery and quantification of KEs in an exhaustive approach, commonly requiring sustained research effort. In this context, the objective of our presented proof-of-concept study was to showcase the identification and characterisation of molecular KEs from the molecular stress response of Chlamydomonas reinhardtii, applying a multilevel approach for elucidating mechanistic data from a diverse range of methodologies, including in silico and in vitro approaches, for use in regulatory decision making. The aim of this work was to develop and test a more comprehensive experimental design, for the targeted characterisation of key events in the toxicological response of Chlamydomonas reinhardtii upon herbicide exposure, thereby contributing to the development of a quantitative AOP. Here we present how an initial hypothesis for an AOP was created from available literate evidence, with focus on ‘omics and multiple-endpoint assay data, for the selected herbicide, norflurazon. This hypothesised AOP allowed development of targeted assays for investigation of predicted key events in a time- and concentration-response methodology. LC-UV was used to monitor suspected toxicological markers of the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific thioredoxin PRX1, and a lipid peroxidation assay was applied for determining downstream effects of non-specific oxidative stress. A concentration- and time-dependent response in phytoene accumulation was observed, whilst concentration dependent b-carotene depletion was shown at later times. After 24 hours exposure the highest binary mixture was identified within an hour of exposure, whilst lipid peroxidation occurred between 4 and 24 hours post-exposure. Significant (p < 0.01) effects on cell number, an adverse outcome, were observed at 2000μg/L after 24 hours. This study highlighted the necessity for use of synchronous algal cultures for accurately understanding mechanism, as this would enable more accurate determination of time- and concentration- responses due to diurnal algal life cycles. Ultimately, this work has shown proof-of-concept and laid the foundation for development of a quantitative AOP for phytoene desaturase inhibition leading to growth inhibition and population decline.
**WE293**

Effects of water-borne benzo[a]pyrene on early life stages of the fathead minnow (*Pimephales promelas*)

M.T. Schmitt, RWTH Aachen University; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; N. Apenova, C. Grimard, University of Saskatchewan / Toxicology Centre; A. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; A. Tollefsen, University of Saskatchewan - Toxicology Centre / Toxicology Centre; D. Green, University of Saskatchewan - Toxicology Centre / Toxicology; K. Bluhm, University of Saskatchewan / School of Environment and Sustainability; T. Lane, University of Saskatchewan; N. Baldwin, J. Taghavimehr, A. Masse, University of Saskatchewan / Toxicology Centre; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences; H. Hollert, RWTH Aachen University / Institute for Environmental Research; N. Hogan, University of Saskatchewan / Toxicology Centre and Department of Animal and Poultry Science, College of Agriculture and Bioresources; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

**WE294**

SETAC OMICS Interest Group

B. Campos, Unilever R&D / Environmental Chemistry

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (P)

WE295

Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications

J. Thaulow, NIVA - Norwegian Institute for Water Research / Freshwater Ecology; L.C. Lindeman, Norwegian University of Life Sciences / Dept. for Basic Science and Aquatic Medicine (BasAm); Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; J. Kamstra, NMBU / BaSaM; L. Xie, NIVA - Norwegian Institute for Water Research; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Daphnia magna is used in toxicology and environmental science as a monitor for ecosystem health. Epigenetic analysis is enabled by the genome of the closely related *D. pulex*. Epigenetic mechanisms allow gene regulation in a developmental context and can be regulated by environmental stimuli. The best studied epigenetic mechanisms are methylation forms on cytosines in a CpG context and post-transcriptional modifications (PTMs) on histone proteins attached to DNA. The global abundance or change of 5-methyl-cytosine (5mC) may indicate epigenetic reactions to environmental stimuli, since these methylation forms facilitate in the regulation of gene expression the change in expression can be detected and compared. This application of next generation sequencing (NGS) to *D. magna* code give insight on how these proteins modifications regulate gene expression and crosstalk with each other and with DNA methylation.

**WE296**

Emergence and multidimensional interactions of engineered nanoparticles in toxicity (P)

WE297

Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution

A. Bertucci, F. Pierron, Université de Bordeaux / UMR EPN CNRS 5805; T. Ye, T. Christelle, IGBMC / CNRS UMR 7104 - Inserm U 964; P. Gonzalez, University of Bordeaux / UMR EPN CNRS 5805; M. Baudrionni, Université de Bordeaux / UMR EPN CNRS 5805

MicroRNAs (miRNAs) are a class of small non-coding RNA. These 20-24 nucleotide-long sequences associate with the 3' untranslated region (3'-UTR) of target messenger RNAs (mRNAs), and post-transcriptionally regulate the expression of numerous genes by mediating translational repression or mRNA degradation. In mammals, more than 50% of mRNAs are predicted to be the subject of miRNA-mediated control. One miRNA may regulate hundreds of target mRNAs, and one mRNA may contain multiple binding sites for multiple miRNAs, thus resulting in a complex regulatory network. Although miRNAs are involved in regulation of almost all cellular processes, such as development, growth, apoptosis, immunity and maintenance of tissue-specific function, mechanistic aspects of this regulation are not fully understood. In Human, the aberrant expression of miRNAs has been linked to various diseases and toxic environmental factors such as heavy metals. The first aim of the present study was to identify miRNAs in the European eel *Anguilla anguilla* by using next generation sequencing. We identified 210 evolutionary conserved and 145 novel miRNAs. Amongst these 375 miRNAs, 242 were predicted to be able to interact with 3,637 transcripts in the previously described A. anguilla’s transcriptome. No gene ontology, nor metabolic pathway, was significantly enriched in the list of target genes, suggesting that miRNAs might affect any biological process. Our second aim was to compare the differential expression of miRNAs between a pristine site located in Arcachon Bay and a polluted site in the Gironde estuary (France). Nineteen miRNAs were up-regulated and 22 were down-regulated depending on the pollution profile. This approach may give new and qualitative molecular markers and the comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicity mechanisms involved between environmental factors and diseases aetiology.

WE298

Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus)

L.V. Laing, University of Exeter / Biological Sciences; H. Littler, J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; N. Fury, Kings College London; R. van Aarle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; R. Wilson, University of Exeter / Biosciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences

The sustainability of fish populations in our increasingly polluted environment is critically dependent on their ability to adapt via (epi)genetic mechanisms. Copper is an essential element but when present at high concentrations in the water it can become toxic to aquatic organisms. Recent studies in the UK suggest that copper is the most significant metal pollutant threatening fish in UK freshwaters. We conducted a series of copper exposures in stickleback to investigate whether prior exposure can result in altered susceptibility in subsequent generations. Stickleback embryos were exposed to 0.015mg/L copper during early life (0-9dpf), causing ~1.2% mortality, ensuring that selection for a tolerant genotype did not occur. They were then kept under control conditions until sexual maturity. Copper pre-exposed fish were shown to have a significantly higher basal copper tissue burden as adults; and upon re-exposure, they showed a differential response compared to control fish. Mortality curves on F1 embryos revealed that embryos originating from parents which were exposed to copper during embryogenesis were significantly more tolerant to copper when compared to controls. This copper tolerance was shown to be still impartably high expression of miRNAs in the multigenerational tolerant phenotype observed was caused by p specific function, mechanistic aspects of this regulation are not fully understood. In Human, the aberrant expression of miRNAs has been linked to various diseases and toxic environmental factors such as heavy metals. The first aim of the present study was to identify miRNAs in the European eel *Anguilla anguilla* by using next generation sequencing. We identified 210 evolutionary conserved and 145 novel miRNAs. Amongst these 375 miRNAs, 242 were predicted to be able to interact with 3,637 transcripts in the previously described A. anguilla’s transcriptome. No gene ontology, nor metabolic pathway, was significantly enriched in the list of target genes, suggesting that miRNAs might affect any biological process. Our second aim was to compare the differential expression of miRNAs between a pristine site located in Arcachon Bay and a polluted site in the Gironde estuary (France). Nineteen miRNAs were up-regulated and 22 were down-regulated depending on the pollution profile. This approach may give new and qualitative molecular markers and the comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicity mechanisms involved between environmental factors and diseases aetiology.
tilapia? J. Kuo, Kaohsiung Medical University, L. Li, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung

Abstract Nanomaterial technology was well developed in recent years, and it lead to the nanomaterials accumulation in the aquatic organism. Otherwise, increased atmospheric carbon dioxide causing the phenomenon of global warming. However, less studies are made about the effect of warming whether increases the bioaccumulation of copper nanoparticles in fresh water fish. The purpose of this study is to assess whether warming synergistically increase the bioaccumulation of copper nanoparticles in tilapia (Oreochromis niloticus). Tilapia were randomly exposure to 25 nm of copper nanoparticle (0.3 mg/L) under different temperature (26, 28 and 30°) for periods of 7 days for uptake and 7 days for depuration, to analyze the accumulation and toxicity upon uptake and toxicity in vivo. Results showed that the copper accumulation of muscle in the high temperature group was higher than that of control group on day 7 of uptake phase, but there were not significant difference. For one day of depuration phase, the copper accumulation of the 30° group was significantly higher than of 26 and 287 groups (p<0.01). However, they are similar accumulation concentration in the end of depuration period. This study concluded that global warming could increase bioaccumulation of copper nanoparticle in tilapia.

WE300 Environmental mixtures of nanomaterials and chemicals: proposal for a consistent nomenclature of mixture effects in environmental organisms

Dorothee Straube, Center for Environmental Research / Bioanalytical Ecotoxicology; R. Altenburger, UKEF Centre for Environmental Research / Department Biocatalysis and Ecotoxicology; S. Naasz, UFHZ Helmholtz Centre for Environmental Research / Bioanalytical Ecotoxicology

A review of the existing literature on mixture effects of nanomaterials (NM) and chemicals in environmental organisms was conducted in order to evaluate the current state of knowledge. More than 120 studies were assessed to explore the relationship between changes in contaminant and NM uptake, bioaccumulation, and toxicity. The specific aim of the review was to describe more specifically the interactions that have been observed and to classify the most common mechanisms. As the literature evaluation demonstrated, the existing evidence for interference of NM and chemicals in aquatic organisms is rather diverse. Based on these observations, we could discriminate at least 7 different categories to capture the evidence ranging from no changes in uptake and toxicity to an increase in uptake and toxicity upon mixture exposure to chemicals and NM: (1) increase in accumulation and no change in toxicity; (2) increase in accumulation and no change in toxicity; (3) increase in accumulation and decrease in toxicity; (4) no change in accumulation and toxicity; (5) no change in accumulation and decrease in toxicity; (6) decrease in accumulation and increase in toxicity. However, we assume that these observations were caused by different underlying mechanisms and processes, hence we developed a process oriented, tiered approach considering (1) Adsorption / Interaction between NM and chemicals, (2) Uptake of NM by organisms, (3) Desorption of chemical inside / outside the organism, and (4) Toxicity. This is the first tiered and data-based nomenclature for these processes, 6 groups were build. Based on these 6 groups, a consistent nomenclature is proposed: (1) Trojan-horse (+) (2) Trojan-horse (+) (3) Surface enrichment (+) (4) Retention (-) Inertism (-) (5) Coalism (-) (6) Coalism (-). According to these grouping, we could discriminate at least 7 different categories to explain the mixture effects. This tiered approach results in a consistent terminology to unambiguously describe the different mechanisms of mixture effects that may occur in environmental organisms. Acknowledgement - DK was partially funded by the German Federal Ministry for Education and Research (BMBF) in the frame of the DaNa2.0 project (Data and knowledge on nanomaterials), grant no. 03X0131.

WE301 Investigating the Trojan horse effect of nanoparticles on an aquatic community - An outdoor mesocosm study

T. Strauss, Research Institute gaia; gaia - Research Institute for Ecosystem Analysis and Assessment; S. Clausen, Research Institute gaia; T. Knautz, M. Hammers-Wirtz, Research Institute gaia; gaia - Research Institute for Ecosystem Analysis and Assessment; S. Claussen, Research Institute gaia; T. Knautz, M. Hammers-Wirtz, Research Institute gaia;

Carbon based manufactured nanomaterials (C-MNMs) are promising materials in nanotechnology. Although both fullerenes and carbon nanotubes have been detected in aquatic organisms, there is a lack of data on their bioaccumulation, bioconcentration and toxicity effects, and on the fate of these materials in the environment. Understanding their fate is important in determining potential human and environmental exposure to anthropogenic pollutants. Most effect studies performed until now dealt with waterborne exposure of single species for short time periods in the laboratory. Here, we present a long-term experiment under environmentally relevant conditions. In particular, the Trojan horse effect has been investigated in this study, in order to obtain more data on the interaction between nanoparticles, other pollutants and biota. In principle, pollutants can become more bioavailable by adsorption to carbon-based nanomaterials. In addition, a spatial transfer of contaminated nanoparticles from the water phase to the sediment could increase the exposure to benthic macroinvertebrates but might also reduce the effect on the planktonic organisms. An outdoor freshwater mesocosm study was conducted with C60 fullerenes and the biocide triclocarban (TCC) using twelve outdoor ponds with a water volume of 3 m³. In addition to uncontaminated controls, both substances were tested alone and in combination. The aim of this mesocosm study is to investigate long-term effects of C60 fullerenes on the community level and to assess their potential to affect the toxicity of TCC. In this outdoor mesocosm study direct and indirect effects of single species as well as community level endpoints such as diversity were evaluated. The taxonomic groups of interest were copepods, zoodenotick plankton (e.g. Daphnia species), and macroinvertebrate species (e.g. chironomids, mayflies, oligochaetes, leeches). Different sampling techniques were used in order to include macroinvertebrates living on and within the sediment as well as hatching insects. In this presentation the results of the mesocosm study will be presented. This work has been supported by the German Federal Ministry of Education and Research (BMBF) as part of the NANO-transfer project.

WE302 Nano silver based products and environmental challenges: toxicity and accumulation in a marine sentinel species

G. Liberti, University of Siena / Department of Physical, Earth and Environmental Sciences; A. Ale, Inail-Conicet; C. Jimena, Instituto Nacional de Lminología (CONICET-UNL); S. Ancora, University of Siena / Physical sciences, Earth and environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

The use of nanomaterials in consumer products is constantly increasing worldwide and their release into the environment is thus expected, especially in aquatic ecosystems, which are considered the ultimate sink. The use of nano silver (AgNP) based products as antimicrobial agents is undergoing a rapid increase in terms of production due to its biocidal properties. Here we studied the impact of AgNP-based commercial products named NanArgen (Nanotek S.A.) on a common marine bivalve sentinel species the Mytilus galloprovincialis in terms of biological responses and Ag accumulation. Animals were in vivo exposed for 96h to NanArgen product containing 20-40nm AgNP, according to the manufacturer, at two different concentration (1 μg and 10 μg/L) using natural sea water (NSW) as exposure media. Lysosomal membranes stability (NRRT) and metallothioneins (MT). Effect on multi xenobiotic resistance (MXR) phenotype was assessed by measuring efflux ABC transporters also in vitro using mussel’s gills. Total Ag was analyzed in exposure waters after 24h and in mussels’ soft tissue after 96h. DLS analysis as well as TEM have been also performed on NanArgen formulation in NSW. A significant increase in lysosomal destabilization and MN frequency was observed in hemocytes of mussels exposed to both concentrations of NanArgen. Furthermore, MT content was significantly higher in digestive gland of mussels exposed only to 10 μg/L while oxidative stress parameters did not show any change compared to controls. A slight negative effect on MXR functionality is observed in vivo. The acute toxicity at 24h in vivo. Chemical analysis confirm Ag exposure and showed a dose-dependent increase of Ag in exposed mussels. In conclusion we can state that this nano silver-based commercial product can induce toxicity even at low concentrations and in short-term exposure scenarios. The observed toxicity of NanArgen underlines the need to further test commercial formulations of nanotechnology-based consumer products instead of bare nanoparticles in order to properly address any risk associated to their use and release into aquatic environment and in non-target aquatic species.

WE303 Effect of gold nanoparticles on feeding, growth and enzymes activity of amphibians

B. Rabelo Costa, Department of Biology & CESAM - University of Aveiro / Biology; C. Quintaniero, Department of Biology & CESAM - University of Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The gold nanoparticles are widely used in medical therapy and cosmetics. In this study, the effect of gold nanoparticles on feeding, growth and enzymes activity of amphibians was evaluated. The relative abundance of papers focusing on engineered nanoparticles, including both freshwater and saltwater species. The knowledge about the potential ecotoxicity of these nanoparticles is essential before their use by society at a large scale, since they will ultimately be released in the environment. Thus, the aim of this study was to determine the effect of gold nanoparticles (Au-NR, 45nm) in the feeding rate, growth and enzymatic activity of the hyla arborea. A significant decrease in feeding rate and snout to vent length (SVL) of tadpoles was observed at concentration equal or higher than 0.004 μg/ml. For biomass a significant effect was observed at concentration 0.007 μg/ml or higher, though, a decrease in weight gain rate was observed at a lower concentration (0.004 μg/ml). At the biochemical level, the activity of enzyme lactate dehydrogenase (LDH) increased at 0.002 μg/ml of Au-NR, that of catalase (CAT) was significantly reduced at 0.005 μg/ml or higher, and glutathione S-transferase (GST) and acetylcholinesterase activity (AChE) were significantly higher, relatively to the control, in the two highest tested concentrations 0.007 and 0.01 μg/ml. The
observed reduction in SVL, added to decreased feeding rates, in tadpoles exposed to Au-NR, are important effects that may compromise the fitness of the organisms, since they may cause a delay in the metamorphosis, leading to a longer exposure period of tadpoles to the chemical and to an increase in the time to reach adult and reproductive stage. The higher activity of LDH, at 0.002 µg/mL, may suggest that tadpoles activate first (at low concentrations of Au-NR) a detoxification pathway involved in the protection against stress. Furthermore, an enhanced reactive oxygen species (ROS) may have led to the inactivation of catalase and other antioxidants like glutathione. The reduction of GST at the two highest Au-NP concentrations, suggest that the cells are inactivating the Au-NP by conjugation with reduced glutathione. The results obtained in the present work indicates that Au-NP may induce several sublethal effects in tadpoles of X. laevis, compromising their fitness. Furthermore, since these effects occur at very low concentrations (as low as 0.002µg/mL) it should be classified as “extremely toxic” (EC20 < 0.1 µg/mL; CEC, 1996), suggesting a high environmental risk.

WE304 Interaction of the biodegradable trilcarboxylic and weathered multiwalled carbon nanotubes (wMWCNT) in freshwater algae: chronic effects & bioaccumulation

L Polkowski, M.P. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

The disposal of various plastic nanocomposites containing multiwalled carbon nanotubes (MWCNT) has become a matter of concern in the last decades. Thus, MWCNT release into the aquatic environment due to degradation of the polymers is inevitable. Changes in their properties might happen by several abiotic influences, like weathering by sunlight radiation. MWCNT undergoed thereby structural changes compared to their pristine state, like formation of hydroxyl and carboxyl groups on the surface of the MWCNT. As a consequence, weathered MWCNT (wMWCNT) has different physical, chemical, and biological interactions than the pristine MWCNT (TCC). This might lead to a different environmental fate of both the wMWCNT and the contaminants in aquatic ecosystems and eventually an enhanced chronic or mixture effect on organisms like freshwater algae. In our studies we examine the chronic effects of wMWCNT and the ‘Trojan horse’ effects of TCC in Chlamydomonas reinhardtii and Pseudokirchneriella subcapitata and Chlamydomonas reinhardtii. Growth inhibition tests were performed according to OECD test guideline 201. In a first part of experiments, the growth inhibition of both species was tested in the range of 10 – 60 µg/mL for TCC and 0.1 – 16.0 mg/L for wMWCNT. The mixture toxicity of a TCC test series (10 – 60 µg/L) and 100 µg/L wMWCNT was additionally investigated on P. subcapitata. A second series of experiments was carried out by adding the highest TCC concentration (60 µg/L) to variable wMWCNT concentrations to figure out, which wMWCNT amounts are necessary to reduce the toxicity of TCC. We determined a concentration dependent growth inhibition of P. subcapitata for TCC and TCC + 100 µg wMWCNT/L with an EC50 of 37 and 36 µg TCC/L, respectively. This amount of wMWCNT appears to be not sufficient to adsorb the entire free TCC from the water phase, which eventually (wMWCNT < synchronous EC50 values) only happened in the first stage. Only in a second experiment it could be shown, that wMWCNT amounts > 1 mg/L reduce algae growth inhibition completely caused by 60 µg TCC/L. Regarding to mixture effects of TCC and wMWCNT to algae, bioaccumulation of wMWCNTs by freshwater algae needs to be investigated, especially in respect to long term incubation times and low wMWCNT amounts. Acknowledgements The work is supported by the European Project Modules2GO-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SINN.

WE305 Comparative assessment of the interactive effects of Carbon-based nanoparticles and Benzo[a]pyrene on zebrafish embryos

C. Della Torre, State University of Milano / Biosciences; A. Ghilaradi, S. Magni, University of Milan; N. Santo, University of Milan / Biosciences; D. Maggioni, University of Milan; C. Landi, University of Siena; M. Parolini, University of Milan / Department of Environmental Science and Policy; L. Madoschi, University of Siena; C. University of Milan / Biosciences; L. Bini, University of Siena; L. De Giacomo, University of Milan; A. Binetti, University of Milan / Department of Biosciences

This study aimed to assess the ecotoxicological consequences related to the interaction of Benzo[a]pyrene (B(a)P) with two CNMs with different physico-chemical properties, namely carbon nanopowder (CNPW) and fullerene (C60). The objective of this aim was to determine which contaminants affect the effective sorption of the hydrocarbon on CNMs was quantified. A thorough evaluation of chemico-physical interactions between the two CNMs and B(a)P has been performed. Embryos were exposed to CNPW, C60 and B(a)P alone and their combination. The uptake of CNMs and B(a)P and their localization in embryos were assessed by immunofluorescence and electron microscopy. To evaluate the toxicity effects of interaction of B(a)P with CNMs, a set of biomarkers of genotoxicity and oxidative stress was applied. Proteomics analysis allowed also the identification of molecular events involved in the responses to pollutants alone and in co-exposure. Overall results showed that the different physico-chemical properties of the two CNMs influenced their interactions with B(a)P and generated distinct toxic effects. Indeed the adsorption on CNPW modified the accumulation of B(a)P, which followed the distribution of the physical pollutant instead of its natural bioaccumulation. On the contrary the co-exposure with C60 did not affect the uptake/distribution of B(a)P. Instead, C60 doped with B(a)P is more prone to sedimentation and less bioavailable for the embryos compared to C60 alone. The integrated results from biomarkers and proteomics showed that different stress response pathways were induced by the adsorption of ZnO NPs on C60 alone and in combination. The CNPWP doped with B(a)P mainly mirrored the effects shown by the physical contaminant rather than by the hydrocarbon, while C60 doped with B(a)P seems to induce a cellular response similar to B(a)P alone. The study highlighted that in the aquatic ecosystems complex interactions are established between pollutants and CNMs which could elicit unexpected ecotoxicological effects.

WE306 IN VITRO TOXICITY OF MODEL ZnO NANO Particles ON HEMOCYTES OF MUSSEL Mytilus galloprovincialis

L. Efthimiou, University of Patras / Department of Environmental and Natural resources Management; N. Anastassi-Papathanasi, University of Patras / Department of Biology; E. Mouzouraklis, Y. Georgiou, University of Ioannina / Department of Physics; S. Dailianis, University of Patras / Department of Biology; Y. Deligiannakis, University of Ioannina / Department of Physics; D. Vlastos, University of Patras / Department of Environmental and Natural resources Management.

Zinc oxide nanoparticles (ZnO NPs, size 58 nm, as calculated using X-Ray diffraction data) were manufactured through Flame Spray Pyrolysis, and their effects were subsequently investigated on hemocytes of mussels Mytilus galloprovincialis. Following the collection and preparation of cell suspensions, mussel hemocytes were treated for 1 h with different concentrations of ZnO NPs (5, 10, 50 and 100 µg mL−1). Dose-effect relationships were significantly different among treatments, suggesting that a detoxification pathway (NR) a detoxification pathway might be induced after exposure to ZnO NPs. Hemocytes treated with sub-lethal concentrations of ZnO NPs (5-25 µg mL−1) showed a significant increase in cell viability compared to control, from a stock solution of ZnCl2, dispersed with a probe sonicator, as well as ZnCl2 (10 and 25 µg mL−1).

WE307 Toxico-transcriptomics as tool to identify nano-specific toxicity profiles

M. Burkard, Eawag Aquatic Water Science / Southern Ocean Persistent Organic Pollution Program; A. Betz, Eawag / UTOX; K. Schirmer, Eawag / Environmental Toxicology; A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and technology / Environment and aquatic biology - Zürich; J. Cabellos, Leitat Technological Centre; M. Almira, Leitat Technological Centre; G. Janer, Leitat Technological Center; M. Diez, Leitat Technological Center / HEHS; M. Burin, Leitat Technological Center.

The use of omics is rapidly increasing in the field of nanotoxicology: an increasing number of studies are aiming to investigate the effects and mode of action of engineered nanomaterials (ENM) in this way. However, a systematic synthesis of the outcome of these studies in order to identify common responses between ENM and organism groups has not yet been performed. We therefore established a computational analysis pipeline with the aim to re-analyze relevant transcriptomic datasets in a consistent manner. The pipeline allows a re-mapping of array probe sequences, followed by established statistical analysis and thus improves data set comparability. Differentially expressed genes (DEGs) are determined by comparison between treated and untreated samples (pFDR < 0.05).

WE308 Zinc toxicity to A549 cells and Daphnia magna changes after iron oxide nanoparticles exposure

J. Cabellos, LEITAT Technological Centre; V. Gonzalez, Leitat Technological Center; M. Almira-Casellas, Leitat Technological Center / HEHS; M. Diez-Ortiz, G. Janer, Leitat Technological Center.

The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is predicted to face a promising nanomaterials, such as ZnO NPs, widely in a variety of new cutting-edge applications. Therefore, the use of iron oxide nanoparticles (IONPs) as an environment remediation tool is predicted to face a promising nanomaterials, such as ZnO NPs, widely in a variety of new cutting-edge applications.
assays taking also into account the predicted adsorption of Zn. The ha-IONPs concentrations used were 0.45g/L and 0.52 g/L for the A549 and the Daphnia magna experiments, respectively. In A549 cells, the incubation of Zn with ha-IONPs did not change the Zn effects on cell viability after 24h in terms of IC_{50} (0.006 g/L vs. 0.010 g/L with and without ha-IONPs, respectively). However, the shape of the dose-response curve became shallower (e.g., the IC_{50} for Zn was 0.070 g/L without ha-IONPs, respectively). This indicates a potential protective effect of IONPs at high metal concentrations and a synergistic effect at low metal concentrations. These experiments were also conducted in the presence of serum proteins, and despite the toxicity of Zn decreased, the same effect of co-incubation with ha-IONPs was observed. Optical microscope images showed that ha-IONPs aggregates were uptaken by the cells during the experiments. Therefore, even if adsorbed on ha-IONPs, NPs were uptake by intracellular compartments. Differences in the relative uptake of free vs. ha-IONP adsorbed zinc as well as intracellular bioavailability of Zn in these two forms would be explaining the changes in the dose-response curve that were observed. Acute studies (up to 48-hours) with Daphnia magna showed a protective effect of the ha-IONPs on the toxicity of Zn. The EC_{50} value for Zn increased from 0.23 mg Zn/L to 1.1 mg Zn/L in presence of ha-IONP. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their adsorption in the exposure media. This settling process would decrease the bioavailable zinc concentration in the exposure medium and therefore its toxicity in Daphnia magna.

WE309 Internalization of graphene-related nanomaterials in fish cell lines J. Kalman, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria / Environment; C. Merino, Grupo Antolin Ingeniería SA; M. Fernandez-Cruz, J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment. The H2020 NanoReg2 project aims to develop and implement grouping and Safe by Design strategies for nanomaterials (NMs). For this purpose, toxicity of selected carbon-based NMs have been assessed in order to refine Safe by Design approaches considering three pillars: safer product, safer use, and safer production process. Graphene-related nanomaterials (GRMs) are among the newest and most important NMs in the marketplace. However, NMs adsorbed into graphene and graphene-based materials have attracted great interest in most areas of science and industry. Nevertheless, the incorporation of these NMs into products inevitably leads to their release into the aquatic environments. In a previous study we assessed the cytotoxicity of tubular-shaped carbon nanofibers (CNFs) and graphene oxide (GO) on fish hepatocytes (derived from tompinnow fish, Porellipsis lucida) and macrophages (derived from carp leukocytes, Cyprinus carpio) (WE310). In general, the observed IC50 values after 72h exposure were higher than 100 μg/mL with some exceptions in the case of CLC cells. In the present work we focussed on the uptake and intracellular fate of these NMs. Cells were exposed to three different concentrations (non-toxic, low toxic and relativley toxic) of each NM for 72h. Transmission electron microscopy was used to investigate possible internalization and intracellular fate of these NMs in hepatocytes and macrophages. All GRMs were visualized in both cells even at the lowest exposure concentrations. Carbon nanofibers were taken up into vesicles of hepatocyte cells in a size-independent manner, whereas in macrophages, longer CNFs were encountered free in the cytoplasm and only the shorter CNFs were localized in membrane-bound compartments. GO sheets were present within vesicles as well as free in the cytoplasm of both cell types. Understanding the behaviour of these NMs in these two systems aid in designing safer materials for the environment. This research is supported by the EU’s Horizon 2020 research and innovation programmes (NanoReg2, Grant Agreement nº 646221 and MSc IF-2016, Grant Agreement nº 746876).

WE310 Molecular mechanism and physicochemical properties of Cadmium-TI02 nanoparticle mixtures when co-exposed to the nematode Caenorhabditis elegans L. Kleene, Humburger University of Applied Sciences (HAW) / Life Sciences; A. Hursthouse, University of the West of Scotland / School of Science; S. Heise, Hamburg University of Applied Sciences / Life Sciences. The number of engineered nanomaterials (ENM) is rising continuously in consumer products and industrial fields. Therefore, knowledge about their ecotoxicity in aquatic and soil systems is very important but rare. Nanoscale titanium dioxide (TiO_{2}) is probably among the most relevant ENMs with a projected accumulation rate in European river sediments of 1.4 mg*kg\(^{-1}\)*yr\(^{-1}\) (Gottschalk et al., 2009). In addition, its toxicity has been shown to increase in two freshwater organisms, the C. elegans and Daphnia. In the present study, the toxicity of the mixture on intracellular calcium release will be investigated applying the following methods: 1) The molecular mechanism of nTiO_{2} and Cd will be investigated with NS8593, a known human TRPM7 ion channel blocker. Because of high reproduction inhibition, the TRPM-like channel gene gon-2 could interact with the mixture. Gon-2 is responsible for gonadal cell division in C. elegans. If Cd is a Ca ion channel blocker, the gon-2 channel may show the same effects under SSR. 2) The mode of action of nTiO_{2}-Cd-agglomerates is still not identified. They could interact if Cd is bound to nTiO_{2} or if Cd and nTiO_{2} are in close proximity. The impact of nTiO_{2}-Cd-agglomerates will be examined using calcium as a potential competitive ligand. 3) The photocatalytic activity of nTiO_{2} could damage cell membranes under SSR and Cd could enter the cell. Measuring the uptake of membrane integrity with propidiumiodid and hexokinase will be tested. First results will be presented. Angelstorf et al., 2014. Environ. Toxicol. Chem., 33, 2288-2296. Gottschalk et al., 2009. Environ. Sci. Technol., 43, 9216-9222. Samet, Abstract SETAC Brussels 2017. Thévenod 2009. Toxicol. Appl. Pharmacol., 238, 221-39.

WE311 Influence of temperature and salinity on toxicity of zinc oxide nanoparticle on the marine copepod Tigriopus japonicus W. Lau, The University of Hong Kong; M.M. Yung, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science. Zinc oxide nanoparticles (ZnO NPs) is in the top 5 most prevalent nanomaterials (NMs) in commercial products. About 93% of ZnO-NP-containing products are paints, cleaning and personal-care products, from which ZnO-NP can be easily leached. Annually, around 250 tonnes of ZnO-NP were estimated to be released from sunscreens alone into the marine environment. However, there are no comprehensive regulations of NMs, including ZnO-NP, in any countries due to the diverse physicochemical properties of NMs and their complicated interactions with the environment. In the marine environment, ZnO-NPs are exposed to various environmental factors, such as temperature and salinity, but influences of these factors on the physicochemical properties and toxicity of ZnO-NP are often tested individually. As both factors co-exist in the environment and may influence one another, it is vital to study their effects concurrently to tease out any potential interactions. This study, therefore, investigates the interacting effects of temperature and salinity on ZnO-NP to a common marine copepod (Tigriopus japonicus) along the Western Pacific coast. Physicochemical properties (aggregate size & ion dissolution) of three zinc-associated compounds, including ZnO-NP, ZnO bulk-particles (ZnO-Bulk) and ZnSO_{4} (ZnSO_{4}), were characterized to compare their toxic mechanisms. Acute toxicity was determined with 96-h standard toxicity tests under nine different combinations of temperature (15, 25 & 35 °C) and salinity (12, 22 & 32 PSU), i.e., a 3 x 3 factorial design. Preliminary results showed that increase in temperature and salinity could increase aggregate size of ZnO-NP and ZnO-Bulk, but reduce their ion dissolution rate. At 25 °C, similar to previous studies which suggest that ZnO-NP is toxic at low metal concentrations used were 0.45g/L and 0.52 g/L for the A549 and the Daphnia magna experiments, respectively. This indicates a potential protective effect of the ha-IONPs on the toxicity of Zn. The EC_{50} value for Zn increased from 0.23 mg Zn/L to 1.1 mg Zn/L in presence of ha-IONP. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their adsorption in the exposure media. This settling process would decrease the bioavailable zinc concentration in the exposure medium and therefore its toxicity in Daphnia magna.

WE312 Multigenerational effects of gold nanorods to Raphidocelis subcapitata and Chlorella vulgaris C. Monteiro, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; C. Venâncio, Department of Biology / Biology; A.L. Daniel-da-Silva, S.F. Soares, University of Aveiro / Department of Chemistry & CICECO, 3810-193 Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; T. Trindade, University of Aveiro / Department of Chemistry & CICECO; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro. In real scenarios, exposure to nanoparticles may occur over several generations, which may exhibit a higher sensitivity (due to the accumulation of adverse effects) or tolerance (due to phenotypic plasticity mechanisms) to the nanoparticle. The aim of this study was to evaluate the multigenerational effects of gold nanorods (Au-NR) running from 8 to 90 μg/ml, for 72h. At the end of the assays, growth rate was quantified and compared among generations, i.e. generations not exposed to (F0) and exposed to Au-NR (F1 to F4). For this, algae were exposed to concentrations of Au-NR ranging from 8 to 90 μg/ml, for 72h. At the end of the assays, growth rate was computed for all generations of each algae. The following phyis-chemical parameters of Au-NR concentrations were monitored: size, morphology and total concentration of Au. In addition, the toxicity of the capping agent...
cetyltrimethylammonium chloride (CTAB) was quantified by exposing both algae to the concentration of CTAB present in the highest tested concentration of Au nanoparticles (25 nm, 0.03 mg/L) and without copper nanoparticle under nitrogen and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5) for 14 days to observe hatchability and mortality. Then, the newly hatched fry were exposed to same condition for 14 days to observe the survival. Results showed that the mortality of embryos had a upward trend, and the hatching rate had a downward trend in exposure group of pH 5.5 compared with that of others pH groups. However, only 28°C/5.5 combined with copper nanoparticle group was significantly increased mortality and inhibited hatchability than that of 28°C/6.5 combined with copper nanoparticle group. While the survival rate of larvae had a significantly downward trend in exposure groups of lowest pH level and highest temperature on days 10. In conclusions, medaka larvae have more sensitive than embryos by survival ability. Moreover, aquatic acidification and warming were synergistic effect to increase copper nanoparticle toxicity to larvae. Therefore, we found that three environmental stressors caused a potential hazards to fish population.

WE314 The use of the marine mussels Mytilus hemocytes as a model for studying the impact of NPs on innate immunity

M. Auguste, University of Genova / DISTAV; T. Balbi, L. Canesi, university of genou / DISTAV

Nanoparticles (NPs) are widespread used in consumer products and industry; they are found in the environment and interact with microbial communities, and they also have potential impact on environmental species. Recent studies have demonstrated that NPs could affect a number of marine species, and interact with their immune system. Within the PANDORA project (Probing safety of nano materials with marine benthic organism to ENMs toxicity in benthic aquatic organisms), a European Training Network (ETN) funded in the framework of H2020 Marie Skłodowska-Curie ITN programme, objectives are to identify immunological mechanisms triggered by nano-objects, and predictive markers of risk vs. safety, with a collaborative cross-species comparison. The use of mussel hemocytes, from Mytilus galloprovincialis, for in vitro testing is a valuable tool in the screening of the toxicity of NPs as the tests are inexpensive and use alternative animals in experimental science. In the last decade, several methods to assess the biological parameters (e.g. lysosomal membrane stability, superoxide and NO production, phagocytic activity) and particle internalisation by hemocyte upon short-term exposure to NPs (different concentrations and times of exposure from 30 min to 1h). Once entering the organism, NPs are in contact with other type of media e.g. hemolymph serum for mussels. For some type of NPs, the response is affected by the type of protein components of hemolymph serum involved in the formation of a NP-protein corona. In order to have a wider view of the interactions and mechanisms of actions of NPs, the same parameters are measured with NPs suspensions in artificial seawater (ASW) and serum. The results obtained with Mytilus hemocytes will be compared with those obtained in immune cells of other model organisms within the PANDORA project. According to the special properties of every NPs, the aim is to understand the main mode of action at the cell level that will help designing predictive in vitro assays to measure the immuno-risk of NPs to the environment in the future. *Funded within the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement PANDORA No 671881.

WE315 Influence of warming and acidification on copper nanoparticle bioaccumulation in medaka (Oryzias latipes) embryo

Y. Zhang, I. Meng Ian, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung; Y. Chen, Kaohsiung Medical University / Biomedical Science and Environmental Biology; W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung

The level of atmospheric CO_2 has elevated significantly since the Industrial Revolution, leading to global warming and ocean acidification. With the development of industry and technology, many emerging contaminants such as copper nanoparticle (CuNPs) may be exposed to environment. However, it is unclear whether the accumulation of copper nanoparticles in organism will increase under the warming and acidification scenarios. Therefore, the purpose of this study is to investigate whether CuNPs (25 nm, 0.03 mg/L) will accumulate in Japanese medaka (Oryzias latipes) embryo under the condition of elevated temperature and lowered pH. The medaka embryo was followed four consecutive days at nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5). Results showed that the temperature and pH did not affect the accumulation of CuNPs, respectively. When combined with temperature and acidification factors, Cu accumulation of group 30°C/6.5 was increased significantly than that of groups of 26°C/6.5, 26°C/5.5, and 30°C/5.5. However, it revealed that there was no significant evidence of warming and acidification on increased Cu accumulation of medaka embryo. Therefore, we concluded that there was no influence of Cu accumulation in medaka embryo when warming and acidification occurs in the future.

WE316 Assessing the combined toxicity of metals and metal-oxide nanoparticles in a benthic estuarine microalgae

R. B. Ogunjimi, M. Y. Allop, G. Barker, University of Bristol

Coastal aquatic ecosystems such as estuaries are at risk of metal pollution due to anthropogenic inputs from acid mine drainage, industrial and agricultural run-off. In addition, advances in nanotechnology in the last decade has increased the production engineered nanomaterials (ENMs) used widely in fields such as medicine, energy, agriculture and consumer goods production. As a result, there are increasing concerns about the release of engineered nanomaterials such as metal oxide nanoparticles into the environment. While the effect of metals and ENMs as single contaminants have been extensively studied, much research is needed to account for potential mixture effects due to heavy metal-ENMs interactions. Studies suggests that the toxicity of ENMs such as metal-oxide nanoparticles is mainly due to the release of dissolved metal ions. However, majority of these studies have mainly focused on impact of ENMs in freshwater environment and results are extrapolated for other types of environmental systems (marine, soil, sediment). Evidence is accumulating that the dissolution of ENMs is dependent on the species, generations; after being exposed for four generation to this metals, Y. Zhang, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung environmental fate and unintentional ecological effects and/or toxicities are included in the ecological risk assessment.

Firstly, the embryos were exposed to 25 nm copper nanoparticle (30 µg/L) and hatchability of early development of Japanese medaka (Oryzias latipes) was investigated. All experiments were conducted in duplicate. After hatch, the larvae were exposed to 25 nm copper nanoparticle (30 µg/L) and without copper nanoparticle under nitrogen and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5) for 14 days to observe hatchability and mortality. Then, the newly hatched fry were exposed to same condition for 14 days to observe the survival. Results showed that the mortality of embryos had a upward trend, and the hatching rate had a downward trend in exposure group of pH 5.5 compared with that of others pH groups. However, only 28°C/5.5 combined with copper nanoparticle group was significantly increased mortality and inhibited hatchability than that of 28°C/6.5 combined with copper nanoparticle group. While the survival rate of larvae had a significantly downward trend in exposure groups of lowest pH level and highest temperature on days 10. In conclusions, medaka larvae have more sensitive than embryos by survival ability. Moreover, aquatic acidification and warming were synergistic effect to increase copper nanoparticle toxicity to larvae. Therefore, we found that three environmental stressors caused a potential hazards to fish population.

WE317 Comparative toxicity of silver nanocolloids and titanium dioxide nanoparticles using medaka

Y. Kato, Toyo University / Faculty of Life Scince; T. Aiyoshi, C. Kataoka, S. Kashiwada, Toyo University / Graduate School of Life Sciences

Silver nanoparticles and titanium dioxide nanoparticles are representative nanomaterials that has been used for multiple purposes in human life. Hence, environmental fate and unintentional ecological effects and/or toxicities have been concerned and many studies are reported using model organisms. We have been investigating fish toxicity and ecological risk of silver nanocolloids (SNCs, 40 nm) using medaka model. SNCS have hemolytic (at 0.5 mg/L of SNCS) and larvae (at 5 mg/L of SNCS) toxicities including lethality, inhibition of embryo development, shortened body length, small eye development, ischemia, reduced heart beating, and caused some oxidative stresses such as GSH reduction and lipid peroxidation. To adults, SNCS exposure (at 5 mg/L) did not exhibit significant lethality; however, it was observed that SNCS exposure (at 0.05 mg/L) disrupted immune system and reduced tolerance to infectious bacterial disease (Edwardsiella tarda). In SNCS exposure, we reported the silver chloro-complexes, which were made of dissociated silver ion from SNCS, should be essential toxicants of SNCS exposure. On the other hands, titanium dioxide nanoparticles (TiO₂-NP, Φ 90 nm) are well-known causing oxidative stress by UV radiation; however, there are some reports that TiO₂-NP does not have significant toxic effect to fish other than
hypertrophy of gill mucus. We have assumed that ion dissociation will be a key to understand nano-toxicity depended on materials. TiO₂-NP which does not dissociate ions, was employed as a reference to ion dissociation NP (i.e. SNCs). In exposure of TiO₂-NP (at 10 mg/L) to embryo and larvae, there was no biological toxic effect mentioned above at all. In our presentation, we will discuss comparative toxicity of SNCs and TiO₂-NP regarding general toxicity, oxidative stress, cytotoxicity (apoptosis and necrosis), immuno-toxicity, and tolerance to pathogenic bacterial disease. Through this study, we will figure out that dissociated ions should be toxic essential of nanomaterials, and not always nanosized material will be toxicant in aquatic environment.

WE318
Genotoxicity assessment of aluminium oxide nanoparticles in relation to Escherichia coli and Aeromonas hydrophila
n. doskocz, M. Załęska-Radziwill, A. Affek, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology
Increasing production and use of nanoparticles contributes to their widespread dissemination in the environment and their unique physicochemical and toxic properties lead to unlimited distribution in environmental compartments. Migration ability of nanoparticles can have very dangerous consequences, as they can be transferred to potable water. Genotoxicity biomarkers are regarded as useful tools for the assessment of chemical hazards in aquatic ecosystems, because chemicals which damage DNA can significantly alter the functioning of ecosystems. Recent advances in molecular biology have led to the development of new techniques, which can be used for DNA analysis in the field of genetic ecotoxicology. The randomly amplified polymorphic DNA (RAPD) method is a PCR-based technique that amplifies random DNA fragments with the use of short primers of arbitrary nucleotide sequence under low annealing conditions. RAPD-PCR test has been used successfully for detection of genetic damage in animals and plants. The SOS-Chromotest is one of the most commonly used bacterial tests. It is based on the induction, by genotoxic compounds, of a bacterial SOS repair system conjugated to the b-galactosidase gene and the subsequent measurement of the enzyme expression. In this work, genotoxicity studies on the basis of the RAPD-PCR and SOS-Chromotest assay were performed for aluminium oxide nanoparticles (nano-Alo₂O₃). L. donovani, L. infantum, and S. mansoni were used on the fate, transport, and effects of nanomaterials, including metal based particles such as nano-Al₂O₃ in the environment. The interest in nano-Al₂O₃ is due to the fact that their influence on genetic material of bacteria is practically unknown. Results obtained for the nanocompound were compared with those for Al₂O₃ macro form. The nanocompound caused changes in the genetic material of bacteria A. hydrophila. Description of genetic sensitivity of obtained profiles was performed. The SOS-Chromotest differed from the results obtained for the negative control by more than 27.3%, while from positive control - only by 15.6%. Furthermore, the largest decrease in genetic stability was 89.3%. The values of genotoxicity induction coefficient (I) in the SOS-Chromotest showed strong genotoxicity for nano-Al₂O₃, in the presence of S9 fraction and slight genotoxicity in the absence of S9 fraction in mutants of Escherichia coli. The results showed also that nano-Al₂O₃ can induce genotoxicity a greater extent than the same compounds in their macro form.

WE319
Effects of Copper Oxide Nanoparticles and Arsenic on the Whole-Life Cycle of Rice (Oryza sativa japonica)
I. Demessie E, Changseok H, Amy M. Simms, P.G. Cobl, Baylor University / Department of Environmental Science
Copper oxide nanoparticles (nCuO) and arsenic (As) phytotoxicity to rice plants (Oryza sativa japonica) was evaluated in a factorial study using (0, 0.1, 0.1, 0, 50, 10, and 100 mg/L) in daily watering and As (0 and 10 mg/kg) in soil. Experiments were conducted in a greenhouse during 130 day interval. Two rice plants were grown in 3L plastic pots without drainage. Toxins were quantified in soils and water by inductively coupled plasma-mass spectrometry before, during and after testing. nCuO particle sizes were determined by differential light scattering before addition to the test system. Exposures began at implanting, continued through germination, and to seed production. Thus, our study is the first to examine the influence of nCuO in combination with As in the whole life cycle of rice plants. No significant effect was observed on the seed germination, but both nCuO and As had a significant main effects on the fresh weight (FW) of rice straw and the number of rice panicles (NP). The interaction of the two toxictants was also significant on both FW and NRP. A decrease in the FW was observed for rice exposed to As, only. The midlevel concentrations (1.0 and 10 mg/L) of nCuO decreased the FW with no As addition, while higher concentrations (50 and 100 mg/L) significantly increased the NRP. Low and high nCuO concentrations (0.1, 50, and 100 mg/L) decreased the FW with the As addition, and NRP decreased in treatments receiving As along with either lower or higher nCuO concentrations. More data from this greenhouse study are currently being compiled and analyzed to determine the effect of As and nCuO on grain yield as well as Cu and As uptake, distribution, and speciation in rice plants and the grain.

WE320
Behavior of cerium oxide nanoparticles in presence of pharmaceuticals
G. AMARIEL, Universidad de Alcala; K. Boltes, Universidad de Alcala / Chemical Engineering; P. Letón, Universidad de Alcala
Nanoparticles, in particular metal oxide nanoparticles, have found extensive usage in a wide range of services and industries. Subsequently, they can be released into the environment and finally end up in water bodies. That may suppose a potential risk to aquatic environment, exerting toxic effects at the level of cells, tissues or the whole organism. The present study, evaluate the toxicity behavior of cerium oxide nanoparticles (CeO₂-NPs) on three aquatic specimens- algae Selenastrum capricornutum, bacteria Vibrio Fischeri, and activated sludge, by exploring concentration-dependent effect and changes induced due to the presence of ibuprofen (Ibu) or Levofloxacin (Levo). 72h algae growth-inhibition, marine bacteria luminescence reduction and 24h sludge enzymatic activity and oxidative stress were used as endpoints. Nanoparticles concentration ranged from 0.6 to 160 mg L¹. The particle size and the ζ-potential of NPs in the culture media were measured to analyze the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of CeO₂ nanoparticles leading to growth inhibition in algae. The presence of Ibu did not produce significant changes, while Levo showed drastic negative effect in algae growth. Short-term exposure produced significant reduction of luminescence intensity in marine bacteria. The presence of both, Ibu or Levo, reduced the negative effects of single nanoparticles in Vibrio Fischeri. Exposure produced significant oxidative stress in bacteria forming activated sludge, with lower damage to enzymatic activity.

WE321
Toxicity of nanoparticles of titanium dioxide to Daphnia longispina: waterborne versus dietary exposure
F. Padilla, Institute for Environmental Sciences / University Koblenz-Landau; C. Venancio, Department of Biology / I. Lopes, University of Aveiro / Department of Biology / A. Venancio, National Nanotechnology Centre / N. doskocz, M. Załęska-Radziwill, A. Affek, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology
Nanoparticles, in particular metal oxide nanoparticles, have found extensive usage in many different fields. TiO₂ NPs) on three aquatic specimens Daphnia longispina, Vibrio Fischeri, and activated sludge, by exploring concentration-dependent effect and changes induced due to the presence of ibuprofen (Ibu) or Levofloxacin (Levo). 72h algae growth-inhibition, marine bacteria luminescence reduction and 24h sludge enzymatic activity and oxidative stress were used as endpoints. Nanoparticles concentration ranged from 0.6 to 160 mg L¹. The particle size and the ζ-potential of NPs in the culture media were measured to analyze the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of CeO₂ nanoparticles leading to growth inhibition in algae. The presence of Ibu did not produce significant changes, while Levo showed drastic negative effect in algae growth. Short-term exposure produced significant reduction of luminescence intensity in marine bacteria. The presence of both, Ibu or Levo, reduced the negative effects of single nanoparticles in Vibrio Fischeri. Exposure produced significant oxidative stress in bacteria forming activated sludge, with lower damage to enzymatic activity. The presence of pharmaceuticals compounds did not produce significant changes on nanomaterials, in particular metal oxide nanoparticles, have found extensive usage in many different fields.
malate dehydrogenase and α Mannosidase, respectively. A high-purity vacuumal (99.5%) and cytochrome (86.7%) fractions of the cells of *Nitilopsis obtusa* were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytoplasmand vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytoplasm. The data on *Cu* accumulation dynamics within the compartments after cell exposure to rCu60 suspensions will be presented and the role of the cell wall in the accumulation process will be discussed.

**WE323 Are graphene nanomaterials "Trojan horse" carriers for oil compounds in mussel hemocytes in vitro?**

G. Nicolussi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU), Basque Country, Spain; A. Katsitou, M.P. Cajaraville, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE.

In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are prioritary pollutants and main constituents of the water accommodated fraction (WAF) of petroleum. Graphene nanoplatelets can adsorb organic compounds thus being potentially useful in oil spill remediation. However, they could also act as vehicles of organic contaminants to aquatic organisms ("Trojan horse" effect). This study aimed to evaluate the "Trojan horse" effect of graphene nanoplatelets. This work was funded by the EU Horizon 2020, GO-polyvinylpyrrolidone (GO-PVP) and reduced GO-PVP (rGO-PVP) with adsorbed oil compounds from naphthenic North Sea crude oil WAF using *in vitro* toxicity assays in hemocytes of marine mussels. Two approaches were tested to obtain graphene nanoplatelets with adsorbed oil compounds: filtration and centrifugation. Hemocytes were exposed to a wide range of concentrations of GO, GO-PVP and rGO-PVP with and without adsorbed oil compounds to a series of WAF dilutions. After 24 h exposure, cell viability (MTT assay) and ROS production were assessed. Centrifugation (270g for 30 min) successfully separated WAF solution from graphene nanoplatelets with adsorbed oil compounds. This procedure was thus used for *in vitro* toxicity testing. WAF decreased cell viability and increased ROS production in hemocytes starting at 25% WAF. GO, GO-PVP and rGO-PVP nanoplatelets were moderately toxic to mussel hemocytes and produced a significant increase in ROS production. In exposures to graphene with adsorbed oil compounds, hemocytes viability decreased at similar concentrations as in exposures to nanoplatelets alone. However, ROS production increased in hemocytes exposed to lower concentrations of graphene with adsorbed oil compounds (10 mg/L) compared to nanoplatelets alone (25 mg/L), indicating that adsorbed oil compounds increase nanoplatelets toxicity. In conclusion, a protocol to obtain graphene nanoplatelets with adsorbed oil compounds was established. Nanoplatelets with and without adsorbed oil compounds showed similar cytoxicity to hemocytes but the ones with adsorbed oil compounds increased ROS production earlier, indicating that graphene nanoplatelets may act as "Trojan horse" carriers. This project was funded by the EU Horizon 2020 GRACE project (grant 679266), Spanish MINECO (project NACE, CTM2016-78113-R), Basque Government (consolidated research group ITS10-13) and University of the Basque Country (UIF 11/37).

**WE324 Multigenerational effects of titanium dioxide and silver nanoparticles on *Daphnia magna*: gene expression and morphological changes in the presence or absence of aged nanomaterials**

L.A. Elia, The University of Birmingham / GESS; E. Valsams-Jones, University of Birmingham / School of Geography Earth and Environmental Sciences; I. Lynch, University of Birmingham / Geography Earth Environmental Science.

Recent studies have investigated nanoparticle (NP) physiochemical properties and interactions with biological systems. *Daphnia magna* was chosen as the model organism, as they are well characterized and reproduce parthenogenetically, which is well suited for experimental genetic studies and monitoring stress/adaptive change to their environments. Herein, we investigated key biological endpoints, such as survival, growth, reproduction, and cellular pathways in response to exposure to silver (AgNPs) and titanium dioxide (TiO2) nanoparticles (NPs). Particles were either pristine or aged, uncoated or stabilized with either PVP or sulphide (AgNPs only). Our aims were to identify specific stress responses from NPs which could lead to molecular defects in order to understand if: (1) different NP compositions induce the same pathways and effects; (2) exposure in the presence of organic compounds such as natural organic matter changes the pathways and/or severity of changes observed; (3) if the ageing of particles make them more or less toxic; (4) if long-term low dose exposure (25 days, EC20 concentrations) leads to developmental and reproductive changes, and (5) whether these NP-exposure induced changes to the F0 generation are passed onto subsequent generations, who themselves are not exposed directly. In all cases, both morphological changes and expression of key biomarkers were analysed in order to identify whether chronic exposure to NPs induces stress responses. We observed morphological changes, including eyes and tail defects, to each of the subsequent F1-F3 generations. We also observed differences in gene expressions compared the control populations, supporting that AgNP and TiO2 do have toxicological impacts from chronic exposure irrespective of particle aging. TEM observations of consequent histological accumulation of the TiO2 and AgNPs supported the assumption that NPs manifest themselves as particulates. We were also able to see some recovery in the F3 generations that had their subsequent parent generations removed from exposure. The influence of biomolecules secreted by the organisms in response to the presence of NPs, and the influence of humic acid containing media during the exposure phase were also investigated, providing important insights regarding the need for realistic exposure scenarios during chronic exposure scenarios.

**Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (P)**

**WE325 Evaluating the contribution of environmental stressors to sediment concentrations of PAHs in the northern Gulf of Mexico**

L.M. Basire, Louisiana State University; H. Rockett, R.J. Portier, Louisiana State University / Environmental Sciences.

Toxicity associated with organic pollutants in aquatic sediments has not been fully characterized for the major estuarine and marine systems of coastal Louisiana. As such, five inshore and three offshore transects of the Mississippi River delta were sampled for sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and environmental variables. From 2012 to 2014, five environmental variables were measured in the northern Gulf of Mexico including dissolved oxygen and 3) temperature of the overlying water column, and 4) the percent moisture sediment and 5) percent organic matter of the aquatic sediment. A main effects-model was implemented in order to assess the impact of environmental variables on the concentrations of ten PAHs and three toxicity indicators in freshwater and marine sediments. A backwards, step-wise linear regression analysis of variance (ANOVA), generalized linear model (GLM) was performed to determine significant effects of measured environmental parameters. The most important environmental variables affecting the concentrations of the measured compounds were those describing the characteristics of the aquatic sediments. The percent moisture of the sediment was the most important environmental parameter, significantly affecting eight of the ten organic pollutants and all three toxicity indicators. Percent organic matter of the sediments was the second most significant parameter, accounting for the variability in concentration for five of the measured pollutants. Temperature was significant for three of the PAHs and TEQ, and in every instance it had a negative effect on concentration. Dissolved oxygen of the water column was a significant variable on the concentration a single organic compound. Water column depth and salinity did not have a significant effect on the concentration on any of the constituents. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physiochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. This current research suggests that sediment organic matter and temperature measurements at each sampling location should be incorporated into monitoring study design in order to more completely interpret the sediment burden of organic pollutants in aquatic sediments.

**WE326 Microbial resistance to chemical pollution by urban effluents might be triggered by desiccation events.**

F. Romero, S. Sabater, ICRA Catalan Institute for Water Research; O. Pereda, University of the Basque Country; l. sabater, CSIC-IDAEA / Department of Environmental Chemistry; C. Font, V. Acuña, ICRA Catalan Institute for Water Research.

Freshwater ecosystems are subjected to different anthropogenic pressures. Among them, wastewater treatment plant (WWTP) effluents can represent a significant proportion of total discharge, mostly in regions suffering from water scarcity. WWTP effluents contain a mixture of assimilable and toxic compounds, which concentration ultimately determines the effect of the mixture on freshwater biota. Moreover, overexploitation of water resources together with climate change-decided pressures is causing drought events leading to desiccation to increase in number and intensity. To date, little is known about how desiccation events shape the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regressional design to evaluate how an acute desiccation event shapes the response of a complex microbial community (i.e. a river biofilm) exposed to a dilution of a WWTP effluent. We found that desiccation and wastewater effluent significantly affected bacterial community and key biofilm processes such as photosynthesis, denitrification and methanogenesis. After the desiccation event, the biofilm associated to coarse sediment showed a stimulatory effect even at low dilution factors, which was not observed under control (i.e. no desiccation) conditions. Our results seem to indicate a simplification of the biofilm community after the desiccation event and a subsequent co-tolerance phenomenon. We argue that the acute desiccation event

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reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism powers biogeochemical cycling in ecosystems, we argue that functioning of freshwater ecosystems may be shaped as a result of the combined action of climate change-related stresses such as desiccation and chemical pollution.

WE327
Synergy effects of fluoride and variability in temperature lead to proportionally greater fitness costs: A multigenerational test
M. Oliveira, University of Aveiro; N. Inocentes, Department of Biology
CESAM University of Aveiro / Biolo; A.M. Soares, University of Aveiro / department of Biology & CESAM; M. Barbosa, Department of Biology & CESAM - University of Aveiro / Biology
Increased variability in water temperature is predicted to impose disproportionately greater fitness costs than mean increase in temperature. Additionally, water contaminants are currently a major source of human induced stress likely to produce fitness costs. Global change models forecast an increase in these two human induced stressors. Yet, in spite the growing interest in understanding how organisms respond to global change, the joint fitness effects of water pollution and increased variability in temperature remain unclear. Here, using a multigenerational design, we test the hypothesis that exposure to high concentrations of fluoride, a human medicine commonly found in freshwater systems, causes greater fitness costs when associated with increase variability in temperature. Although flightless and sexed by genotype, it remains unclear to what extent these factors can not only affect alone, when both stressors acted together the costs were disproportionally greater.

The combined effect of fluoride and variability in temperature led to a reduction of 37% in lifetime reproductive success and a 17.9 % decrease in population growth rate. Interestingly, fluoride and variability in temperature had no effect on the probability of survival. Freshwater systems are of the most imperilled ecosystems, often exposed to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress act on alone. We study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE328
Influence of extreme heat events in the recovery capability of Mytilus galloprovincialis exposed to mercury contamination
E. Coppola, Department of Biology & CESAM - University of Aveiro / Biology; B.M. Henriques, CESAM - University of Aveiro and CINMAR University of Porto / Department of Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; E. Figueira, University of Aveiro / Biology CESAM; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry
Several studies already described the impacts caused by metals in estuarine species, often exposure to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress act on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE329
Impacts of ocean warming and BDE-209 contamination on the energy budget of juvenile white seabream (Diplodus sargus)
P. Anacleto, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seaboard Upgrading; C. Figueiredo, M. Baptista, MARE - Marine and Environmental Sciences Centre; P. Pousão, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seaboard Upgrading; C. Camacho, IPMA, LP.; M. Santos, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seaboard Upgrading; P. Pousão-Ferreira, Portuguese Institute for the Sea and Atmosphere; L. Valente, Interdisciplinary Centre of Marine and Environmental Research; A. Marques, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seaboard Upgrading; R. Rosa, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre Climate change and chemical contamination are global environmental threats of growing concern for the scientific community and regulatory authorities. Yet, the impacts and interactions of both stressors (particularly ocean warming and emerging chemical contaminants) on the physiological responses of marine organisms remain unclear and require further research. In this context, our main goal was to study, for the first time, the effects of warming (+5 °C, i.e. 24 °C) and accumulation of a polychlorinated diphenyl ether congener (BDE-209, brominated flame retardant) by dietary exposure on the energy budget of juvenile white seabream (Diplodus sargus; 3.9±1.2 g total weight), used as a model. Specifically, growth (G), routine metabolism (R), excretion (faeces) and nitrogen losses (U) and food consumption (C) were calculated to obtain the energy budget. The results demonstrated that the energy proportion spent for growth dominated the mode of the energy allocation of juvenile white seabream (50.6-67.8%), including even under the synergistic effect of warming and BDE-209 exposure. On the other hand, energy lost via faeces was significantly higher under control temperature and BDE-209 exposure (16.0%). In all treatments, the energy channelled for metabolism was around 26% and a smaller percentage was channelled for excretion (faeces: 4.3-16.0% and ammonia: 2.3-3.3%). In general, the parameters were significantly affected by increased temperature and exposure to the flame retardant, with higher levels found under warming conditions (for wet weight, relative growth rate, protein and ash contents), BDE-209 exposure (only for O:N ratio) or under both stressors (for ammonia excretion rate and routine metabolic rate). On the other hand, lower visceral somatic index (VSI) was observed under warming and lower fat content was observed under both stressors. Overall, with such extreme and expected conditions of warming and contamination, the energy budget of marine fish species is expected to be greatly affected, leading to impacts on fish fitness and ecosystem processes.

WE330
Transgenerational effects of pesticide on vector mosquito Culex pipiens under global warming
T. Tran, L. Janssens, K.U.Leuven; K.V. Dinh, DTU Technical University of Denmark; R. Stoks, University of Leuven / Department of Biology
Recent transgenerational studies have showed that some species could acclimate to warming and pesticide separately. Transgenerational plasticity is even being considered as a powerful mechanism to enhance species resilience to projected warming. However, it is unknown how exposure to pesticide under warming in the parental generation will shape the offspring susceptibility to these stressors, specifically in vector species. We studied the transgenerational effects of single and combined exposure to warming (4°C increase) and the pesticide chlorpyrifos on life history traits and antipredator behaviors of the vector mosquito Culex pipiens using a half--transgenerational design. Parental exposure to warming and/or pesticide either warming or the pesticide, had negative effects on the offspring: both parental exposure to warming and to the pesticide resulted in an overall lower offspring survival. Parental warming impaired the anti-predator behaviors of the offspring by decreasing the diving proportion and diving time off the offspring. Within both the parental and the offspring generations, warming made the pesticide more toxic in terms of survival. However, this synergism disappeared in the offspring of parents who had been exposed to both stressors simultaneously because in this condition the pesticide was already more lethal at the lower temperature. For anti-predator behaviors, in both generations the two stressors reduced diving time in a synergic way. In the parental generation, the effect of pesticide were stronger at 20°C than at 24°C. In the offspring generation, this synergetic effect depended on parental temperature. Pesticide induced stronger reduction in diving time at 20°C than at 24°C but only in the offspring of parents exposed to 20°C. Our results indicate that transgenerational effects will not increase the ability of this vector species to deal with pesticides in a warming world. This study highlights the importance of using bifactorial transgenerational experiment to understand the combined impact of pesticide and warming across generations, hence to assess the efficacy of vector control in a warming world.

WE331
1 + 1 ≠ 2: Heritage-dependent synergistic development responses in copepods exposed to predator cues and copper
T. T. Lødegård, J.D. Heuschele, T. Andersen, J. Titelman, University of Oslo / Department of Biosciences; K. Nyland, Department of Biosciences, University of Oslo, Norway / Department of Biosciences; K. Børg, Department of Biosciences, University of Oslo / Department of Biosciences
This study examines sub-lethal developmental effects of combinations of predator cues (kairomones, threespine stickleback) and copper (20 µg Cu L⁻¹) on the marine copepod Tigriopus brevicornis. The aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent potential. Potential importance of pedigree was also tested by comparing offspring from different females. Individual nauplii from egg-bearing females (8 randomly picked individuals per females’ clutch) were incubated individually and exposed to one of the four treatments: control, kairomone, copper or kairomone + copper. The experiment ran for 13 days (313 hours) with daily exchange of exposure solutions and simultaneous registration of survival (activity) and development (counting shed exuviae). Food (Rhodomonas salina) was added daily ad libitum. All individuals in control were mature by the end of the experiment. A
2-parametric non-linear mixed effect model was used to describe nauplii development over time \( (Instar = K / (1 + (K - 1) * e^{-(exp \cdot log(mu) + age / m})) \), where \( K \) is the asymptotic development stage and \( mu \) is the average stage transition rate). Effects of treatment and pedigree on the two model parameters were examined by comparison of models with likelihood ratio tests and Akaike's Information Criterion (AIC). This analysis finds that treatment influenced developmental stage at the end of the experiment, while pedigree affected the time to reach it. Developmental effects were found to be significantly different for development stages of surviving individuals. When all individuals in control had reached maturity (288 hours), individuals exposed to the combined treatment kainorome + copper were significantly delayed compared to all other treatments. Effects on individuals in the combined treatment were greater than expected based on the two treatments alone. An adverse effect on development was already evident at the time of the first emerging copepods (138 hours). These results indicate a synergistic relationship between risk of predation and copper by increased age at maturity in developing individuals of \( T. brevicomis \). The results also show the significant role of pedigree in determining development rate. This highlights the need to consider both natural stressors and individual heterogeneity when conducting ecotoxicological studies.

**WE332**

Functional and structural soil-vegetation indicators of ecosystem functioning in metal-contaminated environments: a case study in SE Spain

J. Alvarez-Rogel, A. Peñalver Alcalá, M. Tercero Gómez, H. Conesa Alcaraz, O. Muñoz Vighi, A. García Pasqualini, A. Rico Varela, H. Conesa Alcaraz, O. Peñalver Alcalá, M. González García, L. Nozal, IMDEA Water Institute / Earth and Environmental Sciences; M. González-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM Functional and structural soil parameters of six environments defined by stages of vegetation development were studied in abandoned agricultural fields and mountainous environments. The environments were: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of Pinus halepensis trees (2-5) ≤2.5 m high, growing scattered (P); 3. Isolated P. halepensis trees >3.5 m high with shrubs and herbs under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (>5) >3.5 m high and shrubs and herbs under the canopy (DP+MS); B) Outside the mine tailings: 5. Polluted forest with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 6. Control mature forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF). Ecological indexes of vegetation were evaluated and soils analyzed for physical, chemical, and biological parameters. Soil temperature, feeding activity of invertebrates and decomposition were measured in situ. P+MS, DP+MS and PF showed the highest diversity of plant species and P the lowest. The organic C/N ratio was ≈20 in P+MS, DP+MS, PF and CF and ≈13 in S and P, which was in accordance with larger accumulation of litter in the first four environments. Cation exchange capacity (CEC), an indicator of the buffer capacity of the soil and the stability of the organic matter, was largely higher in CF (>32) followed by PF (>20), P+MS and DP+MS (<12) and finally P and S (<5). Water soluble metals and metal-organic compounds were analysed from microbial biomass (indicator of micro-organisms population) followed the same pattern than CEC. Total metal(loid)s concentrations (mg kg⁻¹) widely varied within the tailings, without a clear pattern related with plant colonization (e.g. Pb: 5400-14600; Zn: 8600-18000; As: 200-1200). Water soluble metal(loid)s (µg kg⁻¹), the most toxic fraction, were largely higher in S (e.g. Pb=4600, Zn=210000). Tea bag compost composition showed two different tendencies: DP+MS, P+MS and S had a higher weight loss than PF, CF and P. Feeding activity was (% of holes fed upon): CF =42%, P = 39%, S = 31%, P+MS =21%, AF =88%, DP+MS =67%. Total and soluble/available metals concentrations cannot be considered the only factors related with the activity of bacteria in polluted sites. Field studies including physical, chemical, and biological parameters must be considered together to obtain realistic information for understanding soil ecosystem functioning and recovering.

**WE333**

Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions

A. Rigó, A. A. Salinas, IMDEA Water Institute / Aquatic Ecosystemology; J. Pasqualini, A. García-Astillero, L. Cherta, L. Nozal, IMDEA Water Institute; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences

Neonicotinoids are a group of insecticides that are used worldwide in agriculture including piercing-sucking and chewing insect pests. These insecticides are considered contaminants of emerging concern due to their high toxicity to non-target organisms and to the aquatic environment. It is therefore important to assess their potential impact on aquatic communities. The experimental design followed a distinct pattern as a combination of the Concentration Addition (CA) model for the prediction of the toxic effect of mixtures of chemicals with the same mode of action may be applied to describe the short term effects of complex communities and not only individual organisms. However, some of the recorded indirect effects and the recovery of some populations showed slight differences between the imidacloprid and the neonicotinoid mixture treatments. It was attributed to the different dissipation rates of some of the test compounds included in the mixture as compared to imidacloprid. Therefore, it may be concluded that the CA model provides an accurate prediction for short-term effects at the population and community levels but requires the inclusion of other lines of evidence (e.g. ecotoxicological modelling results) to predict long-term effects and recovery. Some aquatic insect taxa (Chironomus plumosus) were found to be highly sensitive to neonicotinoid concentrations under Mediterranean conditions. The lowest calculated NOECs from this study are below 0.2 µg/L for imidacloprid and for the neonicotinoid mixture, indicating that the current water quality criteria proposed by regulatory agencies and recent scientific publications (0.2 µg/L) may be underprotective for lentic aquatic ecosystems under Mediterranean conditions. However, due to the high variability of the results at the low test concentrations, the hypothesis must be confirmed by performing more specific tests.

**WE334**

Multiple stressor effects of quantum (γ) radiation and non-irradiating (UV) radiation on IR duckweed (Lemna minor)

L. Xie, NIVA - Norwegian Institute for Water Research; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; O.C. Lind, K.A. Solhaug, B. Salbu, Norwegian University of Life Sciences; K. Toltden, NIVA / Ecotoxicology and Risk Assessment

In nature environment, aquatic biota is facing to the ionizing radiation emitted from natural radiogenic radionuclides and radioactive waste in the environment. This work is focused on the study of the effects of the combined action of quantum and non-irradiating radiation (UV) on aquatic biota. The objective of the present work was to study the combined effect of low-dose γ-radiation (13.2, 20.3 and 47.1 mGy/h) and UVR (UVB 0.5 mW/m²) in the aquatic plant duckweed (Lemna minor) using a combination of genomic, functional and adverse toxicity endpoints. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days' exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency (Fv/Fm) and oxidative phosphorylation (OXYPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PS II operating efficiency (Fv'/Fm'), electron transport rate (ETR) and reactive oxygen species (ROS) formation. Single UVR caused similar effects as γ-radiation. The combination of Fv/Fm, Fv'/Fm', pigment content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h). Multiple stressors affected the primary production going. We found that the combination of ionizing and non-irradiating radiation reduced L. minor reproductive rate at high dose. We identified the most relevant toxic pathways being perturbed by the single and multiple stressors tested. Combined study with radiations and chemicals are currently in going.

**WE335**

Natural organic matter determines the potential of titanium dioxide nanoparticles to mitigate pesticide toxicity in presence of UV light

S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; V. Gerstle, F. Meyer, R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bundschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment

Natural organic matter (NOM) determines the potential of titanium dioxide nanoparticles (nTiO2) to mitigate the toxic effects of pesticides in aquatic ecosystems. The objective of this study was to elucidate the mechanism of action of nTiO2 on two diatoms (Chaetoceros muelleri and Amphora transversa) using a combination of genomic, functional and adverse toxicity endpoints. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose. We identified the most relevant toxic pathways being perturbed by the single and multiple stressors tested. Combined study with radiations and chemicals are currently in going.

**WE336**

Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions

A. Rigó, A. A. Salinas, IMDEA Water Institute / Aquatic Ecosystemology; J. Pasqualini, A. García-Astillero, L. Cherta, L. Nozal, IMDEA Water Institute; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences

Neonicotinoids are a group of insecticides that are used worldwide in agriculture including piercing-sucking and chewing insect pests. These insecticides are considered contaminants of emerging concern due to their high toxicity to non-target organisms and to the aquatic environment. It is therefore important to assess their potential impact on aquatic communities. The experimental design followed a distinct pattern as a combination of the Concentration Addition (CA) model for the prediction of the toxic effect of mixtures of chemicals with the same mode of action may be applied to describe the short term effects of complex communities and not only individual organisms. However, some of the recorded indirect effects and the recovery of some populations showed slight differences between the imidacloprid and the neonicotinoid mixture treatments. It was attributed to the different dissipation rates of some of the test compounds included in the mixture as compared to imidacloprid. Therefore, it may be concluded that the CA model provides an accurate prediction for short-term effects at the population and community levels but requires the inclusion of other lines of evidence (e.g. ecotoxicological modelling results) to predict long-term effects and recovery. Some aquatic insect taxa (Chironomus plumosus) were found to be highly sensitive to neonicotinoid concentrations under Mediterranean conditions. The lowest calculated NOECs from this study are below 0.2 µg/L for imidacloprid and for the neonicotinoid mixture, indicating that the current water quality criteria proposed by regulatory agencies and recent scientific publications (0.2 µg/L) may be underprotective for lentic aquatic ecosystems under Mediterranean conditions. However, due to the high variability of the results at the low test concentrations, the hypothesis must be confirmed by performing more specific tests.
toxicity of Primicarb was reduced 1.7-fold with increasing UV (0.00 vs 2.20-2.60 W/m²). In presence of NOM, Primicarb toxicity was generally decreased (up to 2.3-fold, e.g. 0.00 W UV/m²). Depending on pesticide type and factor combinations we observed both positive and negative effects of UV radiation on the toxicity of the selected pesticides. A general prediction on the combined effects of nTiO₂, NOM, and UV on the toxicity of pesticides seems currently difficult. Rather, physiochemical properties like pesticide structure, solubility, adsorption, and degradation seem to be crucial for the interaction with nTiO₂, NOM, and UV, and the ultimate pesticide toxicity.

WE336 Effects of inorganic sunscreen formulations on the algal symbionts of reef building corals, Symbiodinium spp., and their combined toxicity with ocean warming
A. Tagliani, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Hennige, The University of Edinburgh / School of Geosciences; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences
Between 4,000 and 6,000 tons of sunscreens annually are washed from the skin by swimming and snorkeling, and directly released into the water, posing a potential threat to coral reef ecosystems. Titanium dioxide nanoparticles (nTiO₂) are common UV filters in cosmetic products, and in typical sunscreen formulations they are dispersed in an oil phase, a mixture of emulsifiers and emollients which can reach up to 20% of the product content by weight. In order to assess the impact of inorganic sunscreen on corals’ endosymbiotic algae (Symbiodinium spp.), three nTiO₂ with different sizes and surface coatings were dispersed in an oil phase to mimick commercial available sunscreen formulations. Two Symbiodinium phytootypes, known for their different tolerance to environmental change and stress, were exposed to oil:nTiO₂ dispersions at both ambient temperature (26°C) and thermal stress condition (32°C). Growth rates, maximum photosynthetic activity and reactive oxygen species (ROS) production were evaluated. Symbiodinium spp. exposed to sunscreen show negative effects on all endpoints studied, and the toxicity is enhanced with simultaneous heat stress. Results indicate toxicity is not dependent on the type of nanoparticle and it is likely driven by the oil carrier, a major ingredient in all cosmetic sunscreens. Released oil, and the nanoparticles in the oil droplets, accumulate in the water surface microlayer and sediments due to its lipophilic characteristics and resistance to biodegradation, constituting a major risk to marine organisms. Corals rely on the photosynthetic provided by the endosymbiotic algae for their nutrition, and the production of excess ROS by Symbiodinium cells as a consequence of heat stress, is considered to be a trigger of coral bleaching (the loss of Symbiodinium from the coral host). The significant decrease of maximum photosynthetic activity at 32°C coupled with the algal growth decline, and direct release of the oils in the water, poses a potential threat to coral reef ecosystems. The increased ROS production following sunscreen exposure, in addition to the reduction of photosynthetic activity, provide evidence that exposure to these types of sunscreens may exacerbate bleaching response in corals and pose a risk to coral reef ecosystems in a changing ocean.

WE337 Metallothioneins as an indicator of metal exposure in a naturally mineral enriched aquaculture environment
H. Pienaar, C. Wolmarans, G. Van Niekerk, NorthWest University School of Biological Sciences / Zoology; V. Wepener, North-West University - School of Biological Sciences / School of Biological Sciences
The Marico River system, in the North West province of South Africa, is relatively unaffected by anthropogenic activities. However, metal concentrations – mainly from natural sources – occasionally exceed environmental quality guidelines or toxic concentrations. Macroinvertebrates are capable to react to these metals through processes such as the induction of metallothioneins (MTs). The aims of this study were to determine whether the induction of MTs can be used as indicator of natural metal exposure in anthropogenically impacted systems and whether there are relationships between metal concentrations in water, sediment and macroinvertebrates and concomitant MT levels. This was done by sampling macroinvertebrates, water and sediment from eight sites in the Marico River and tributaries. Water and sediment samples were prepared and analysed with an ICP-MS to determine metal concentrations. Seven families including Notonectidae, Coenagrionidae, Atyidae, Libellulidae, Baetidae, Caenidae and Chironomidae were selected and digested for metal analyses. Four families including Gerridae, Aeshnidae, Atyidae and Coenagrionidae were also analysed to determine their MT concentration. To test for possible relationships between metal concentrations in the macroinvertebrate families, MTs and metal concentrations in the water and sediment, Spearman’s non-parametric correlation tests were performed among sites. Positive correlations were found between metal in sediment and macroinvertebrates, while there were no correlations between metal concentrations in water and macroinvertebrates. Even in freshwater river systems with a relatively low human impact and no mining activities, a positive correlation existed between trace metal bioaccumulation (e.g. Ni, Pb, Zn) in macroinvertebrates and the induction of MTs. There were, however, no correlations between MTs and bioaccumulation of earth metals (e.g. Al, Fe, Mn, Ti). These data clearly demonstrate the application value of MTs as biomarkers for metal exposure in freshwater systems.

WE338 Mollusks as indicators of environmental pollution (case studies in marine mussel Mytilus galloprovincialis Lam. and terrestrial snail Bradybaena fruticum Mull.)
T. Kazneova, Saint-Petersburg Scientific Research Center for Ecological Safety Russian Academy of Sciences / Lab Bioelectronic Methods for Geocological Monitoring; S. Khlokovkevich, Saint-Petersburg Scientific Research Center for Ecological Safety, V.M. Makeeva, Earth science Museum of Lomonosov Moscow State University; N.N. Kamardin, Saint-Petersburg Scientific Research Center for Ecological Safety Russian Academy of Sciences; A.V. Smurov, Earth science Museum of Lomonosov Moscow State University
Snails are widely used as sentinel species in marine and terrestrial biomonitoring. Their wide distribution in different biotopes, high sensitivity to pollution makes them good bioindicators in environmental quality assessment. The comparability of mollusks in pure and polluted sites was performed in field studies around Moscow Region and in Moscow city as well as for marine bioindication in a few locations round Sevastopol city. Cardiac activity registration in selected mollusks was carried out as a tool for measuring deterioration of general health of local biota in the sites of the concern. Methodology with standard testing of heart rate (HR) and HR variability using functional loads (short-term temperature, salinity change, some mechanical stimuli, etc.) were carried out. In land biodiagnostics a 3-4 years old genetically modified morphs of bush snails Bradybaena fruticum (Mull.) were used collected from Moscow city (Kartmazovo, Kuz'minki,Izmailov Park) with respectively the lowest HR variability and most of bush snails from natural sources. The only compared comparison was done based on cardiac activity monitoring in mentioned groups of snails under thermal treat (20-50min, 50±0.5°C). It was revealed that snails of the same genotype (striped and without strips) from chemically polluted sites (Kartmazovo, Kuz'minki) differed in lower thermosteresis from those of the reference site and Isaaklovsky Park demonstrated in dynamics of HRs. The effect of temperature on toxicity of cypermethrin on Daphnia magna
P.T. Kajankari, University of Helsinki / Department of Environmental Sciences; V. Juuttila, University of Helsinki; A. Rantalainen, University of Helsinki; O. Penttinen, University of Helsinki / Faculty of Biological and Environmental Sciences; S. Kholodkevich, Saint Petersburg Scientific Research Center for Ecological Safety Russian Academy of Sciences
Cypermethrin is an insecticide which European Parliament of the Council has classified as a priority substance in Directive 2013/39/EU in the field of Water Policy. The Annex II of the Water Policy sets the environmental quality standards (EQS) for the priority substances. Cypermethrin’s annual average and maximum allowable concentration in inland surface waters are 0.08 ng/L and 0.6 ng/L respectively and annual average and maximum allowable concentrations in surface waters are 0.008 ng/L and 0.06 ng/L respectively, one of the lowest annual average and maximum allowable concentrations in environmental quality standard. The abiotic stressor like the temperature can have an effect on toxicity of the chemical. Previous studies have shown that the temperature of the environment affect the toxicity of pesticides belonging to the pyrethroids which cypermethrin is part of. The 48 hour half maximal concentration (EC50) and median effective time (ET50) values were tested with custracean Daphnia magna immobilization at the temperatures 10°C, 16°C and 20°C in laboratory experiments. Cypermethrin was almost twice as toxic at 10°C (2.17 ± 0.20 µg/L) compared with 20°C (4.10 ± 0.30 µg/L). The EC50 value of 16°C was 2.64 ± 0.21 µg/L which was closer to EC50 value of 10° than 20°C. The temperature had statistically significant effect in the EC50 experiment. The temperature did have a slight effect in the ET50 experiment. The ET50 value at 10°C was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16°C and 20°C. The only statistically significant difference between the temperatures was between 10° and 16°C. The temperature dependent behavior of cypermethrin was not taken into account when the environmental quality standard for cypermethrin was set by European Union and the United States Environmental protection agency’s reregistration eligibility decision for cypermethrin. With pyrethroids deltamethrin and permethrin the Canadian guidelines do not take account effects of temperature. When guidelines and legislations are prepared to certain chemicals some abiotic factors like the temperature should be considered. Key to changing guidelines and legislation is to take account the possible effects of temperature in test standards.

WE339 Pattern oriented food web modelling of metal mesocosm datasets
K. Viang, Ghent University / GHeEnToxLab; F. De Laender, Université de Namur
Pattern oriented food web modelling of metal mesocosm datasets in SETAC Europe 28th Annual Meeting Abstract Book
K. Viaene, Ghent University / GhEnToxLab; F. De Laender, Université de Namur

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ecotoxicity data has been accumulated. The most informative tests performed for the ecological effects of toxicants are mesocosm studies: controlled experiments where the effects of toxicants on model communities are studied for extended periods of time. Mesocosm studies are cost- and labor-intensive but offer a unique insight into realistic ecological effects of toxicants: they address not only direct effects on sensitive species, but also indirect effects resulting from ecological interactions (e.g., competition, predation) between sensitive and less sensitive species. Typically, the effects occurring in mesocosm studies are however complex and difficult to interpret. A study has been set up to investigate whether food web modelling could reveal additional patterns, trends, or interactions in existing copper and zinc mesocosm datasets. Pattern oriented food web modelling – an ecological modelling technique – is used to reveal the mechanisms underlying metal effects. When different abiotic factors are considered in multiple predictor patterns in the datasets will be identified and described. Models are then evaluated for their ability to reproduce these patterns. In the case of mesocosm studies, food web models can be applied to understand the mechanism behind observed patterns. A large diversity of food web models exists with large differences in their complexity and underlying theories. Food web models based on ordinary differential equations are relatively simple in structure while they can still account for the interactions between species in the food web. They are therefore ideally suited to study mesocosm data. Additionally, the effects of environmental parameters such as temperature and pH, often key determinants of metal toxicity, can be included. Finally, the potential Pathway of Effects – explaining how metal toxicity leads to the observed patterns – can be evaluated to identify the most important drivers of metal toxicity in the mesocosm food webs and derive community-based threshold levels.

**WE341**

**Bioaccumulation and physiological conditions in Rudipatna philipinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy)**: Application of Cannabinoid/shell weight index

E. Canzian, ISPRA Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; V. Bernarello, R. Boscolo Brusà, G. Franceschini, G. Sesta, C. Maggi, D. Berto, M. Gabellini, C. Virno Lamberti, ISPRA Institute for Environmental Protection and Research

**Rudipatna philipinarum** (Adams & Reeve, 1850) is a soft-bottom dweller bivalve commonly used in biomonitoring programs, especially in bioaccumulation assessment, owing to its high tolerance to toxic compounds. However, bioavailability and accumulation of contaminants in the soft tissue of molluscs could be affected by abiotic factors, such as food availability, pH and temperature, and also by biotic factors, such as the seasonal changes of flesh weight in molluscs. In this context, some issues could arise especially when comparing different sites in a time period, while they can still account for the interactions between species in the food web. In this study, bioaccumulation of metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Butyltins (BTs) in Manila clams was monitored twice a year, from November 2010 to June 2015, in order to assess impact of human activities on *R. philipinarum* population from the Vallona Lagoon, a transitional area located in the delta of the Po River (NE, ITALY) which is the largest and most important Italian watercourse and one of the main sources of contaminants to Adriatic environments. Although levels were quite consistent with those reported from other geographical areas with low to medium pollution, seasonal trends were showed for each contaminant with higher concentrations on autumn rather than on spring surveys. The physiological condition of clams was also examined through two indices (condition index and survival in air) and they both exhibited seasonal trends. The data obtained from different periods of the year were used to estimate the impact of the changes in environmental conditions (temperature, dissolved organic carbon and trophic status) on the various mangrove sites were eventually evaluated to identify various determinants of metal toxicity, can be included. Finally, the potential Pathway of Effects – explaining how metal toxicity leads to the observed patterns – can be evaluated to identify the most important drivers of metal toxicity in the mesocosm food webs and derive community-based threshold levels.

**WE342**

**Biomonitoring of Singapore mangroves using biomarker expression and contaminant burden in caged green mussels, Perna viridis.**

G. Cheong, National University of Singapore Science Institute; G. Bayen, McGill University / Singapore-Delft Water Alliance; E. Segovia, C. Koh, W. Lee, National University of Singapore; B.C. Kelly, National University of Singapore / Civil & Environmental Engineering

Mangroves are fragile coastal ecosystems whose ecological and socioeconomic importance for adjacent ecosystems and local populations is being clearly recognized nowadays. Mangroves are one of the most threatened tropical environments and our understanding of the impact of chemical pollution on these ecosystems is still at its infancy. In this study, nine mangroves sites were selected around Singapore coastline to cover various contamination profiles, and green mussels, *Perna viridis* were used as bioindicators. Bivalves were deployed in cages at each of the nine mangrove patches for 28 days on two consecutive years (one year during the monsoon period and the other year during a dry-weather period), and collected for subsequent analysis. A series of biochemical and cellular biomarkers were developed and measured using various organs. Metallothioneins (MTs), Glutathione-S-Transferase (GST), Ethoxyresorufin O-deethylase activity (EROD), Vitellogenin-like protein (VLP), Induction of Acetylcholinesterase (AChE) were measured in the bivalves’ digestive tissue. Mussel’s haemolymph was also used to evaluate various immunological parameters (Total Haemocyte counts, phagocytosis and lysozyme levels) and the level of haemocytectomy’s DNA damage, using the Comet assay. Results of this study revealed different profiles of biomarker expression between the various sites. Most notably, metallothionein induction was enhanced at some of the sites, indicating potential exposure to heavy metals while higher levels of DNA damage and EROD were also recorded at some of the mangrove patches pointing towards possible exposure to organic contaminants. Some biomarkers appeared to be subject to seasonal variations while others were very stable. Possible correlation between biomarker expression and the level of various contaminants (metals, PAHs, pharmaceuticals, endocrine disruptives chemicals, personal care products) in caged mussels were also studied. Using an Integrated Biomarker response index, the various mangrove sites were eventually ranked amongst each other. Our findings ultimately indicated a clear segregation of mangrove sites, indicating that some mangroves patches were potentially more at risk than others towards chemical contamination.

**WE343**

**Impacts of climate change on mercury bioaccumulation in large ocean predators**

E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences; A.T. Schartup, Harvard T.H. Chan School of Public Health / Department of Environmental Health; C. Thackray, Harvard University / School of Engineering and Applied Sciences

**Ruditapes philippinarum** (Linnaeus, 1758), the Manila clam, is one of the main sources of contaminants to Adriatic environments. Alt...
WE345 Long-term effects on transplanted caged-freshwater bivalves Diplodon chilensis to the assessment of water quality in a Patagonian river M.S. Yuesspeune, Facultad de Ciencias Exactas y Naturales Universidad de Buenos Aires / Department of Biochemistry, IQUIBICEN-CONICET, FCEN-UBA; S.E. Sabatini, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Biochemistry, IQUIBICEN-CONICET, FCEN-UBA; Bianca B. Bonifazi, Universidad Nacional del Comahue, Neuquén / INIBIOMA-CONICET, CEN; J.M. Castro, INIBIOMA CONICET CEN / Laboratorio de Ecotoxicología Acuática INIBIOMA; C.M. Luquet, CONICET / Laboratoy of Aquatic Ecotoxicology, INIBIOMA; I. Rocchetta, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Chemistry Biochemistry, M.d. Rios de Molina, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica, CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN)

Population growth and human activity are contributing to habitat deterioration in Patagonian rivers with the consequent threat to water quality and biodiversity. The bivalve Diplodon chilensis is a key species in the macroinvertebrate fauna of Patagonian lakes and rivers which has been proposed as a sentinel organism in the area. We evaluated the long-term effects of transplantation of caged D. chilensis to different sites in the Chimehuin river (reference site S1), downstream from an aquaculture facility (S2), and downstream from an open dump and from the sewage treatment plant (S3) after 3, 6, 9 and 12 months of exposure. We combined the antioxidant response, oxidative damage, ROS production and energetic status, with water and sediment analysis (physico-chemical and biological variables, and organic matter content). Physico-chemical variables varied according to site and time of exposure. Sites S2 and S3 showed generally higher chlorophyll a concentration and total coliform bacteria values compared to site S1, whereas organic matter content in the sediment was elevated only at site S2. In D. chilensis, gill SOD and GST activity was higher in both S2 and S3 than in S1 by the end of the exposure time. During the last month of exposure (month 12), GSH levels dropped dramatically and lipid peroxidation levels increased in individuals from S2 and S3 sites. Digestive gland factor (DGF) and energy values in digestive gland were increased at sites S2 and S3, from 6 to 9 months of exposure. Our results indicate that despite the large flow rate of Chimehuin river water quality is deteriorated in areas impacted by anthropic activities (aquaculture, solid waste disposal and sewage). This effect is reflected by a physiological response of D. chilensis, which is especially significant during period of their highest metabolic activity (austral fall/winter).

WE346 The influence of selected seasonal and anthropogenic phenomena on a perennial river in South Africa. G. Van Niekerk, North West University (Potchefstroom Campus) / Zoology-School of Biological Sciences; C. Wolmarans, H. Pienaar, North-West University - School of Biological Sciences / Zoology

The quality of surface waters worldwide is declining fast. This is due to anthropogenic activities such as change and natural occurring floods and droughts which are predominant abiotic agents of disturbance in intermittent streams. The objective of this study was to establish whether seasonal fluctuations can reduce the effect of anthropogenic impacts on the river and whether this is reflected by macroinvertebrate assemblages, physico-chemical water parameters and metal concentrations in the water and sediment. Water quality and macroinvertebrate community data were collected in the Crocodile River (South Africa). Four surveys were conducted, two during the low-flow and two during the high-flow season. Spatial and temporal variations were found with regard to suspended solids and total organic material. The low flow surveys had a slight increase in suspended solids and total organic material, whereas a substantial increase occurred during the high flow season. The highest concentrations of metals in the water column were in contrast to the sediment concentrations observed during the high-flow seasons at the majority of the sites. Only minor differences in sediment metal concentrations were noted between high and low flow seasons. The pH values increased from the origin of the river downstream. However this did not result in a clear trend with regard to either an increase in sediment metals or a decrease in the concentration of dissolved metals. The mean physiological condition of the highest values were obtained during the low flow seasons, when compared to the high flow seasons. A combination of biological indices (Taxa Richness, Shannon-Wiener diversity index and Pielou’s evenness index) were calculated for each site and season, and no significant differences were found between the high and low flow seasons for any of the indices at each of the sites (P>0.05). The highest percentage of families at all the sites and seasons were classified as highly tolerant and tolerant to organic enrichment. It can be concluded that the high flow seasons (associated with rain and floods) did not have a rejuvenating effect on the river, as mentioned in previous studies. This phenomenon is substantiated by the metals concentrations, total organic matter, total suspended solids, electrical conductivity and the fact that all the taxa collected in large numbers during both seasons were tolerant to highly tolerant.

WE347 Growth, Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat Wave and Drought

A. Diksaityte, Vytatus Magnus University; R. Dagilute, Vytatus Magnus University / Environmental Science Department; L. Kubile, D. Mitikelytė, G. Juozapaitienė, Vytatus Magnus University

Extreme climatic events such as heat waves and drought periods are predicted to increase in frequency and severity in many regions under future climate scenarios, and in natural environment these two abiotic stresses often occur simultaneously. The short-term (3 day-long) impact of +10 °C heat wave treatment 6.5 h per day was investigated on Hordeum vulgare under well-watered and water deficit conditions in Closed-top chambers under controlled environment. The decreases in shoots dry weight, shoots length and leaves area were observed in the water deficit treatment after exposure to heat wave, while all these parameters in the well-watered treatment were not affected significantly. The decline in photosynthetic growth under water deficit conditions was most likely caused by a considerably greater reduction in photosynthetic rate as well as far stronger oxidative stress caused by combined impact of heat wave and drought than from single heat wave treatment as revealed by higher level of malondialdehyde content and considerably stronger stimulation of antioxidative enzymes. Full recovery of photosynthetic processes and water content of leaves were observed in control after 3 days of heat wave treatment after one day regeneration period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by high temperatures compared to control. This study revealed and unveiled an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

WE348 Does elevated CO2 protects plants against heat waves damage? J. Zaltsaukaite, Vytatus Magnus University / Department of Environmental Sciences; G. Sujetoviene, I. Januskaitiene, A. Diksaityte, D. Miškelytė, G. Kacienė, G. Juozapaitienė, R. Juknys, Vytatus Magnus University

The frequency and severity of heat waves is increasing as a result of climate change. Extreme climatic events may severely impact crop growth. The experiment was conducted in controlled conditions and revealed an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

WE349 Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosm study

A.A. Sanchez, IMDEA Water Institute / Aquatic Ecotoxicology; I. López, L. Nozal, IMDEA Water Institute; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

Combined stress of Heat wave and Drought

Water scarcity and chemical pollution are two of the main groups of stressors causing ecological impairment in freshwater aquatic ecosystems of (semi-)arid regions. Predictions about human and climatic pressure on water resources in these regions reveal that the interaction between these two groups of stressors will increase in the nearby future. In line with that, advances in ecological risk assessment recognise that stress factors harming aquatic ecosystems rarely operate individually. Therefore, new approaches to assess interactions between multiple stressors are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperature and in natural environment these two abiotic stresses often occur simultaneously. The short-term (3 day-long) impact of +10 °C heat wave treatment 6.5 h per day was investigated on Hordeum vulgare under well-watered and water deficit conditions in Closed-top chambers under controlled environment. The decreases in shoots dry weight, shoots length and leaves area were observed in the water deficit treatment after exposure to heat wave, while all these parameters in the well-watered treatment were not affected significantly. The decline in photosynthetic growth under water deficit conditions was most likely caused by a considerably greater reduction in photosynthetic rate as well as far stronger oxidative stress caused by combined impact of heat wave and drought than from single heat wave treatment as revealed by higher level of malondialdehyde content and considerably stronger stimulation of antioxidative enzymes. Full recovery of photosynthetic processes and water content of leaves were observed in control after 3 days of heat wave treatment after one day regeneration period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by high temperatures compared to control. This study revealed and unveiled an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

WE349 Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosm study

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Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosm study

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Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosm study

A.A. Sanchez, IMDEA Water Institute / Aquatic Ecotoxicology; I. López, L. Nozal, IMDEA Water Institute; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology
population level. Lufenuron was the main stressor in all the environmental scenarios, with a significant decrease of Cladocera and Copepoda, and an increase of Rotifera. Temperature and drought had slight effects on community composition and accelerated insecticide dissipation, influencing community recovery capacity. Interaction between factors at community and population level was mainly observed at the beginning of the experiment. Direct and indirect responses at population level varied between environmental scenarios. The results of this study contribute to understand differences in vulnerability of aquatic ecosystems to multiple stressors in (semi-)arid regions.

WE350 Toxicity of phenoxy herbicide: the effects of elevated temperature and CO2 concentration J. Zaltauskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sujetovienė, A. Diksaitė, J. Januskaitiienė, G. Kacieė, G. Juozapaitienė, D. Miškelė, Vytautas Magnus University; S. Sakalauskienė, J. Miliuskienė, Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; R. Juknas, Vytautas Magnus University Climate change is a major concern for agriculture because of changes in crop productivity. Crop productivity strongly depends on crop protection measures such as use of herbicides. Climate change will influence the fate and ecotoxicity of herbicides by altering their environmental partitioning and degradation, distribution and abundance of weeds and growth and development of weeds and crops. Different responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the coaggregation of insects. The aim of the study was to examine the influence of elevated temperature and CO2 on the effects of phenoxy herbicide to spring barley (Hordeum vulgare L.) and common lambsquarters (Chenopodium album L.). Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO2) and future climate (25 °C, 800 ppm CO2). The terrestrial target Ch. album and non-target H. vulgare plants, growing together in the microcosms in a control (2.1), were sprayed with herbicide sprays solutions equivalent to 0.5-2 of field application rate. The plants were sprayed at the four to five-leaf stage with herbicide solutions prepared with 4-Chloro-2-methylphenoxyacetic acid (MCPA, CAS No. 94-74-6, Sigma-Aldrich). The growth and production of fine particulate organic matter (FPOM production) was determined using a simplified trophic chain: the shredder Sericostoma vittatum (Cordulegaster boltonii) and their natural stressors, such as predation. Perception of predation risk alone may change the behaviour and physiology of prey species, impacting their fitness and, thus, alter their susceptibility to chemical exposure. There are thus growing efforts to understand the combined impacts of toxicants and biotic stressors may affect populations, food web dynamics and ecosystem functioning. Chlorantraniliprole (Cry) was used as a model compound as an anthranilic diamide largely applied due to its specificity for insect ryanodine receptors (ryanodine receptors) of target species. So, to assess the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the behavioural and developmental responses of *Chironomus riparius*. Plus, we tested whether the responses of the *C. riparius*, a collector, would change in the presence of a predator species and the associated production of fine particulate organic matter (FPOM). For that, trials were performed using a simplified trophic chain: Alnus glutinosa leaves as food resource, the shredder Sericostoma vittatum, the collector *C. riparius* and their natural predator the dragonfly Cordulegaster boltonii. A full factorial design tested the effects of the CAP (0 or 2 µg/L), presence/absence of the predator *C. boltonii* and of three herbicide concentrations loss (0.25, 0.5, 1 mg/L) showed that exposure to an environmentally relevant concentration of CAP decreased leaf decomposition in all treatments. Predation risk marginally reduced shredder effects on leaf decomposition. Considering detritivores interaction, an interspecific competition is suggested since the presence of shredders impaired chironomid performance despite the increased in leaf fragmentation. *C. riparius* growth rate was thus decreased independently by all factors (CAP exposure, predation risk and shredder presence) and a marginal interaction between CAP and predation risk was also observed. To conclude, this study highlights the need to consider natural biotic stressors and species interactions in risk assessment of chemical pollution, since both vertical and horizontal diversity play their role on response to stress.

WE352 How sugarcane and high temperatures are contributing to amphibian declines in Brazil? Morphological, biochemical and molecular approaches J. Freitas, University of Sao Paulo - USP / Department of Hydraulic and Sanitation; E.A. de Almeida, Fundação Universidade Regional de Blumenau; D. Schlenk, University of California-Riverside / Department of Environmental Sciences; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation Sugarcane is the most efficient first-generation source of ethanol in the market, which has contributed to the rapid expansion of its crops and generated concerns related to its environmental impacts to Brazilian territory. In tropical areas, agricultural activities of sugarcane are intensified during the rainy season, which coincides with the period of occurrence for many amphibian species. Tadpoles and other aquatic animals from tropical areas of the world also experience large temperature fluctuations in their habitats. So, there is a great concern that amphibians are not only being affected by pesticides in their environments, but also by the combined effects of pesticides and temperature changes. In this study, we evaluated biochemical, morphological and molecular effects caused by the exposure to herbicides used on sugarcane crops in Brazil (diuron and its metabolite, 3,4-DCA, clomazone and sulfentrazole) on tadpoles of different species, using different thermal gradients. Our results showed that temperature is an important factor influencing the toxicity of pesticides in tadpoles. Diuron combined to higher temperatures accelerated metamorphosis process in tadpoles of *Lithobates catesbeianus*. The levels and morphogenesis expression genes (dia2, dio3, thi3, tra, irf2 and hif1β) were mostly upregulated in these groups, showing disrupting effects of diuron for amphibians. 3,4-DCA presented similar responses to diuron on *L. catesbeiana* and its effects were also pronounced at higher temperatures. Native tadpoles of *Rhinella schneideri* and *Euphenedes nattereri* had their antioxidant defense system affected by exposure to the herbicides clomazone (C36) and sulfentrazole. Sulfentrazole and clomazone altered antioxidant enzymes and induced lipid peroxidation with temperature associated responses in tadpoles of both species. Clomazone also increase carboxylesterase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulfentrazole or clomazone in *R. schneideri* and *E. nattereri*. Our results can be used to elucidate the combined effects of herbicides and temperature on amphibian tadpoles, and its effects can be pronounced at higher temperatures. These findings imply that the effects of abiotic factors should be taken into account to evaluate the real risks of exposure of amphibians to commonly used pesticides, mainly in tropical areas.

WE353 Adaptation vs. acclimation of natural phytoplankton communities towards herbicide exposure S. Rizzuto, Lancaster University / Lancaster Environment Centre; D. Baho, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / Lancaster Environment Centre; E. Lee, Akvaplan-niva A/S, L. Nizzetto, NIVA Freshwater ecosystems are subject to natural and anthropogenic disturbances such as climate change, landscape management, natural resources overexploitation and also pollution. Chronic background contamination by pesticides applied in agriculture poses a selective pressure on natural phytoplankton communities, favouring species and strains that can handle herbicide exposure better than others. Under the selection pressure, there might be a development of mechanisms towards a specific substance over time. It can be expected, however, that the community resulting from the historic exposure to the stressors is not uniformly well optimized to utilize available resources in the best possible way. The hypothesis behind this study is drawn from the following concept: The history of community exposure to chemical pollution in the environment influences the sensitivity of responses to contemporary stressors. Herbicides may persist for several physiological aspects of time, depending on whether it is underpinned by purely ecological or evolutionary processes and on the ability of the ecosystem of recruiting diversity and the structure necessary to cope with new environmental conditions. In order to assess these hypotheses we have studied the effect of long-term adaptation vs. acclimation in a two phase community level experiment with natural phytoplankton communities from a pristine and an agricultural catchment. Using a controlled experimental setup, phytoplankton communities were germinated from sediments with and without herbicide exposure (Isoproturon, nominal concentration – 12 µg/L) in phase 1. Afterwards (Phase 2), we subjected the resulting communities to a stress experiment where we applied 4 different concentrations of the same herbicide (S. Rizzuto, M.D. Baho, K.C. Jones, L. Nizzetto, NIVA) at each different species, using different thermal gradients. In the second phase, the communities were exposed to different herbicide exposure during germination (Phase I). A full factorial design tested the effects of the CAP (0 or 2 µg/L), presence/absence of the predator *C. boltonii* and of the herbicide concentrations loss (0.25, 0.5, 1 mg/L) showed that exposure to an environmentally relevant concentration of CAP decreased leaf decomposition in all treatments. Predation risk marginally reduced shredder effects on leaf decomposition. Considering detritivores interaction, an interspecific competition is suggested since the presence of shredders impaired chironomid performance despite the increased in leaf fragmentation. The *C. riparius* growth rate was thus decreased independently by all factors (CAP exposure, predation risk and shredder presence) and a marginal interaction between CAP and predation risk was also observed. To conclude, this study highlights the need to consider natural biotic stressors and species interactions in risk assessment of chemical pollution, since both vertical and horizontal diversity play their role on response to stress.

WE354 Impacts of climate change on freshwater pesticide exposure T. Sinclair, University of Sheffield / Animal and Plant Sciences; A. Boxall, University of York / Environment Department; L. Malthby, The University of Sheffield / Dept. of Animal & Plant Sciences; S. Beulke, Enviresearch / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology Maclean Building Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active
pesticide ingredients. Temperature, rainfall, soil parameters, pest ranges and cropping patterns are all expected to alter under climate change conditions, and all of these parameters could affect pesticide use and environmental exposure patterns which will alter the risk that these compounds pose to the environment. Here, we report the results of a study to evaluate the impacts of climate change on the exposure of aquatic systems in the UK. Concentrations of a number of case study pollutants covering a range of physico-chemical properties and uses, were modelled in streams across the UK using two models recommended by the Forum for the Co-ordination of Pesticide Fate Models and their Use, namely MACRO and PRZM. Model predictions were obtained for current conditions and for expected conditions in the 2080s by parameterising the models for current and future predicted weather conditions, cropping patterns, soil properties and pesticide use patterns. The results show that exposure patterns of the APIs are likely to change in the future. These changes in exposure vary by pesticide type and the region modelled with exposure in some chemical-region combinations increasing and in others decreasing.

WE355 Ranking micro pollutants in effluent by exposure indices evaluated via suspect/nontarget screening

P. Naree, Changwon National University / Environmental Engineering; J. Jeon, Changwon National University / Environmental Engineering. Information on the occurrence and concentration of micro pollutants in effluents from wastewater treatment plants (WWTPs) provides important clues for evaluating the risk and availability of river ecosystems. However, the chemical monitoring work for the numerous trace contaminants is time-consuming, labor-intensive, and cost a lot. To overcome the problems, the efficient monitoring programs have been conducted for limited, but prioritized pollutants. In general, the prioritization has been mainly based on effect/toxicity information rather than exposure relevance. In this study, we determined, by using LC-MS/MS (QExactive® Orbitrap) within a suspect list, about 60 compounds were tentatively identified and ranked by the score. After purchasing reference standards for high ranks, about 20 micro pollutants were orthogonally confirmed and roughly quantified. The prioritized micro pollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatoryatories (acetaminophen, mefenamic acid), antibiotics/antifungal (climabazole, fluorocazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazepine), antithiamines (diphenhydramine, fexofenadine), antihypertensive agent (ibesartan, valsartan), antipsychotic (amitriptyline), antitumor (sulfamethazine), and antiviral (valacyclovir, foscarnet). The concentrations for the top ranker, acetaminophen detected in all 7 samples, was ranged up to 1,300 ng/L. The 2nd ranking pollutant was caffeine and followed by cimetidine > mefenamic acid > fexofenadine > carbamazepine > ibesartan > fluorocazole > diphenhydramine > sulfamethazine. Since some tentatively identified pollutants were left unconfirmed, the prioritized compound list should be updated along with additional confirmations. Nevertheless the ranked list still include highly exposable micro pollutants which are worthy for intensive monitoring in effluents.

WE356 Interspecific effects of temperature shifts on life parameters, oxidative stress, and expression of fatty acid synthesis genes and heat shock protein genes in two congeneric copepods Tigriopus sp.

J. Hung, Sungkyunkwan University / Biological Science; J. Lee, Sungkyunkwan University. In this study, we compared the effects of temperature changes on lifecycle parameters, intracellular reactive oxygen species (ROS) levels, glutathione S-transferase (GST) enzymatic activity, and gene expression profiles of both the de novo lipogenesis (DNL) pathway and heat shock protein (hsp) genes in the temperate copepod Tigriopus japonicus and the Antarctic copepod Tigriopus kingsejongensis. The median lethal temperature (LT50) and no observed effect level (NOEL) in T. japonicus were determined to be 35.3°C and 32°C, respectively, in comparison to 29°C and 2°C per day. In T. kingsejongensis, LT50 and NOEL were determined to be 28.4°C and 12°C, respectively. Levels of ROS and GST activity were slightly elevated (<em>P</em> = 0.05).

WE357 Effects of water burning on zooplankton physiology and fitness driven by food characteristics in a long-term enclosure experiment

L. Minguze, LIEC (CNRS UMR 7360, Université de Lorraine) / Laboratoire Interdisciplinaire des Environnements Continentaux, CNRS UMR 7360; E. Sperfeld, University of Oslo / Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences; S.A. Berger, J.C. Nejstgaard, Leibniz Institute of Freshwater Ecology and Inland Fisheries / Dept. Experimental Limnology; M.O. Gessner, Leibniz Institute of Freshwater Ecology and Inland Fisheries. IGB. Ecotoxicological assays using Daphnia species are generally performed under optimal food and light conditions. However, results of such assays may not adequately reflect stress responses in the wild, since the ability of organisms to cope with adverse conditions critically depends on the amount of available energy. One type of potential stressors is terrestrial-derived dissolved organic carbon (tDOC) that causes browning of lakes and streams, but long-term effects of tDOC on freshwater organisms are not sufficiently known. Using a combination of an in situ enclosure experiment and laboratory incubations, we tested whether long-term tDOC exposure affects the physiology and life-history traits of the waterflea Daphnia longispina, and whether any observed effects are reversible. Daphnids were collected from a long-term, large-scale enclosure experiment conducted in a clear-water lake in northeastern Germany, where a natural plankton community was exposed to a standard source of tDOC (HuminFeed®). The physiological state of daphnids in the enclosures was followed after addition of the tDOC. In the first week of exposure, daphnids experienced oxidative stress, i.e. an imbalance in favour of oxidative damage, but this response was no longer observed after 36 days. Daphnids and water from the enclosures sampled again after 10 weeks were used to assess survival and reproductive performance under laboratory conditions. Both survival and reproduction were related to sex traits and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water showed higher fertility than their counterparts in clear water (A). This unexpected outcome is explained by higher sex ratio and quality in enclosures receiving tDOC, related to a higher abundance and biomass of nutritious food algae. Moreover, transplantation of daphnids from A to B enclosure water and vice versa revealed considerable plasticity, as the daphnids were capable of quadrupling their biomass to a similar level as that observed in the species systems. Although there is indeed evidence that a number of research findings are solved organic carbon (tDOC) that causes browning of lakes and streams.

WE358 Interactive effects of multiple stressors on estuarine processes

A. O’Brien, The University of Melbourne; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; M. Mayer, University of York / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre; A. Chariton, Macquarie University / Molecular Ecology and Toxicology. Natural systems are threatened by a variety of different anthropogenic stressors. These are often considered in isolation, but in reality most are found in combination and have the potential to interact with different outcomes. Urban systems such as estuaries and harbours are commonly exposed to chemical (e.g. contaminants), physical (e.g. low dissolved oxygen), and biological (e.g. invasive species) stressors. It is important to understand the interactive threats posed by these stressors. Here we use a systematic literature review to explore selected urban stressors and their potential interactions under current environmental conditions. We link the interactive effects to responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are relevant to marine and estuarine systems, we identified pollutants that were left unconfirmed. The prioritized compound list should be updated along with additional confirmations. Nevertheless the ranked list still include highly exposable micro pollutants which are worthy for intensive monitoring in effluents.

WE359 Ecology or reproducibility crisis? - Lessons from a laboratory scale tri-trrophic test system

V. Riedl, Environment Department, University of York / Environment Department; A. Agatz, IBACON GmbH / Environment Department; R. Benstead, Fera Science Ltd / Centre for Chemical Safety and Stewardship; R. Ashauer, University of York / Environment. In recent years, concerns have been raised regarding a lack of reproducibility in scientific research. There is indeed evidence that a number of research findings are not reproducible by others or even within the original laboratories. Yet, while the reproducibility of results might often be difficult, it is essential in the context of regulatory decision making. In the environmental risk assessment of pesticides, for example, replication, standardization and reproducibility are of great importance to ensure the reliability and robustness of test findings. For this reason, rapid single-species tests that only allow for the assessment of direct pesticide impacts are still more frequently used than multi-species systems. Although they are ecologically more relevant, micro/mesocosms often yield lower statistical power due to higher complexity, difficulty of standardization, resource demand and variability among replicates. However, growing evidence suggests that direct effects measured at the individual level do not proportionally translate to impacts at the population and community level. The use of testing procedures that are ecologically more realistic and ideally comply with regulatory needs should thus be a priority to risk assessors and regulators. The tri-trrophic aquatic test system
TriCosm (P. subcapitata, Ceriodaphnia, Hydra) was developed as an intermediate link between single-species tests and complex multi-species systems, to detect small stressor-induced alterations in ecological interactions. The achievement of standardization, replication and reproducibility was given close attention during the development of the system, yet, the TriCosm was found to be compliant in terms of repeatability and reproducibility only in the short term. Here we present experiments designed to discern effects of variation due to ecologically important factors that impact on the community dynamics in this aquatic multi-species system.

WE360 Improving tolerance to natural and chemical stressors by inducing early life stages in the rotifer Brachionus sp. Cyanin
L.G. Almeida, MARE – Marine and Environmental Sciences Centre / Instituto Politécnico de Leiria; C. Ferreira, Politecnico Institute of Leiria / Politecnico Institute of Leiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; P. Bossier, Universiteit Gent / Laboratory of Aquaculture & Artenia Reference Center; C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria

Rotifers are widely used as bio-indicators and models for ecotoxicology due to characteristics such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larvae in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural stressors occurring in life, derive acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cyanin (MRS10 and IB3a), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artenia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25ºC and 25 ºC as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0-4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. The sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquatic culture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those greater tolerances and assess if their maintenance can be achieved through several generations. 

WE361 Effects of a mixture of pharmaceuticals in a freshwater model ecosystem
S. Joachim, INERIS-UMIR SEBIO / CIVS; V. David, INERIS; K. Nott, Société World Residues; M. Sant, Institute de l’Environnement / Laboratory Toxicology; H. Queau, N. Delorme, Iseta Lyon / MHE ALMALY Laboratoire Ecotoxicologie; K. Kossey, Université de Liège UlG; P. Baudoin, C. TURIES, INERIS / INERIS UMIR SEBIO ECOT; A. Catteau, A. Bado-Nilles, INERIS; M. Fourage, Unamur; O. Gelfand, Iseta / MHE ALMALY Laboratoire Ecotoxicologie; J. Porcher, INERIS / INERIS UMIR SEBIO ECOT; A. Gelfand, Université de Reims Champagne Ardenne; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology; R. Beaudouin, INERIS / Models for Ecotoxicology and Toxicology METO

Owing to their ecological importance, freshwater producers provide important services which leads to a strong societal demand concerning the preservation of their quality. They are the receptors of the effects of environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural stressors occurring in life, derive acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cyanin (MRS10 and IB3a), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artenia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25ºC and 25 ºC as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0-4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. The sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquatic culture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those greater tolerances and assess if their maintenance can be achieved through several generations.

WE362 Relationships between aquatic toxicity, chemical hydrophobicity and mode of action: log kow QSARs revisited

Quantitative structure toxicity relationships (QSARs) between chemical hydrophobicity and toxicity have been shown for nearly 100 years in both mammals and fish, typically using the log of the octanol-water partition coefficient (kow). The current study reassessed the influence of mode of action (MOA) on aquatic toxicity-log kow relationships using a comprehensive database of curated and standardized acute toxicity and consensus log Kow values, and weight of evidence median MOA classifications. Log kow QSARs were developed as linear regressions of log acute toxicity and log kow for 50 different combinations of taxa (e.g., fish, invertebrates, species-specific) and MOA (6 broad; 3 specific narcosis subtypes). MOA categories included narcosis (non-polar, polar, ester), acetylcholinesterase inhibition, neurotoxicity, electron transport inhibition, ions/osmoregulatory/circulatory impairment, and reactivity. Forty-eight of the 50 MOA-based models were statistically significant (p < 0.05; most p < 0.001), but r² values were generally less than 0.5, particularly for non-narcosis MOAs. The results showed that MOA-based Qsar models can improve the accuracy of aquatic toxicity predictions for a range of taxa, and that incorrect classification of a specific acting chemical can result in toxicity prediction errors greater than 1000 fold.

WE364 Data-mining: Making use of aquatic lower-tier data for higher-tier risk evaluation of agrochemicals
G. Eck, U. Memmert, E. Eschenbach, Eurofins Regulatory AG

Apart from delivering relevant toxicity data, standard lower-tier toxicity studies on aquatic organisms also provide valuable additional information for higher-tier testing strategies for risk assessments for plant protection products. While typically only the standard endpoint (e.g. 96-hour LC50) is used, the thorough analysis of existing studies (i.e. individual tests or combined knowledge from different studies) as well as possible adaptations of standard test designs at the organism group of concern may provide valuable facts like time-dependency or reciprocity of an endpoint. The magnitude and exposure duration or information about relevant sensitive life stages. This additional information may be relevant in context with higher-tier testing strategies as revised exposure testing or to justify the deployment of time-weighted average surface water concentrations for risk evaluation. Gaining of this additional information should be taken into consideration for planning of lower-tier studies with the most relevant organisms. For example spacing of the test concentrations or additional assessment dates during the test period can maximize the knowledge that may be retrieved from these tests with regard to potential risk refinement. This poster presentation gives examples on how results of standard ecotoxicity studies can more efficiently be used as basis for higher-tier approaches in the environmental risk assessment of agrochemicals.

WE365 Comparison of models and tools for derivation of species sensitivity distributions (SSDs) for use in pesticide risk assessment
L. Azevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; G. Schmidt, BASF SE

EFSA’s guidance document for the risk assessment of edge-of-field aquatic organisms (EFSA, 2013;11(7):3290) recommends the use of species sensitivity distributions (SSD) as a second-tier approach for the aquatic risk assessment of plant protection products. For macrophytes, the hazardous concentration to 5% (HC5) of tested species can be attained by deriving a species sensitivity distribution (SSD) composed of effective concentrations to a 50% effect on the growth rate of primary producers (Er50). Various probability distributions are available for the derivation of a SSD (e.g., lognormal, loglogistic) as well as publicly-available tools (RIVM’s ETX, MOSAIC). SSD from the University of Lyon, US EPA’s SSD
WE366 Effects on NTA communities: HCx vs NOEC designs
F. M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
We discuss two examples of field fauna study designs with non-target arthropods (NTA). In both cases a hay meadow was chosen as a paradigm representative for off-field habitats at risk. One example concerns an HC approach where EC, for various x were estimated from a field experiment and used to derive a Species Sensitivity Distribution. The other example concerns a more “classical” approach whereby a limited number of taxa were tested in a replicated block design and the NOEC endpoint was found via statistical hypothesis testing. The results and caveats of both approaches will be discussed and a protocol for evaluating and documenting statistical and biological significance of a NOEC study design will be presented.

We analyse whether “No Effects” may have statistical or biological causes. In the HC-study consistent dose-response curves were obtained within 4 major arthropod taxa (63 out of 776; 8%) and SSD’s could be constructed for each of them. Due to full overlap of curves the classes could be combined, resulting in narrow confidence intervals. In the NOEC-study 66 from 596 (11%) taxa were valid for univariate analysis, representing all major taxa. The protocol developed for the classification of results yielded an informative evaluation and allowed results to be classified as inconclusive or conclusive on a confidence scale of 1-4. Both study designs were fit for purpose and thus are biologically and statistically valid results. Where the HCx-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE367 α-Dominance versus β-Prominence
F. M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
The NOEC or an equivalent regulatory set ECx - value are key endpoints to assess safety of pest control challenges and the assessment takes place in a multispecies context, e.g. in non-target arthropod (NTA) field studies. To date most ecotoxicological faunistic NTA field studies follow a hypothesis test design. Few examples can be found that address ECx -finding by extrapolation from a regression model, such as the SSD-curve. There are two risks associated with hypothesis tests: the producers’ risk and the consumers’ risk, both known as Type 1- and Type 2-errors that I- warn for. We address two issues that I argue are related to frequencies a and b, respectively. This contribution challenges the dominance of b and underscores the prominence of a when it comes to consumer safety. After all, a false positive result in a regulatory context implies a potential economic loss (re-testing, lost market share, lack of appropriate protection agents), whereas a false negative result implies a risk to environmental health. Statistical insignificance (P>0.05) should thus be interpreted biologically and statistically valid results, where the HCx-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE368 Defining simple toxicity values (EC, BMD) is not so simple
E. Bilger, Université de Lorraine, CNRS UMR 7360; F. Latras, Helmholz Center for Environmental Research - UFZ GmbH; V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); S. Devin, LIEC. CNRS UMR 7360, Université de Lorraine / LIEC, CNRS, M. Schmitt-Jansen, UFZ - Helmholtz Cite Environm. Research / Department of Bioanalytical Ecotoxicology; M. Deligne-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionary Biology
Effective Concentrations (ECs) have now largely supplanted No Observed Effect Concentrations (NOEC), after decades of statistical criticisms towards the latter. ECx has a simple definition which sounds unambiguous. However, depending on the concentration-response pattern, its derivation is not trivial and should be paid attention to the concept of ecotoxicological risk assessment. We recently developed a workflow for high-throughput concentration-response modelling of omnics data (e.g., transcriptomics, metabolomics). Such data often displayed non-monotonic trends (U or Umbrella shape) as well as linear and exponential trends. Due to our results, sigmoidal concentration-response shape was more the exception than the rule, as also reported in the literature for such omnics data. In this context, we will discuss and explain why these non-sigmoidal trends lead to several issues regarding the derivation of toxicity values. In particular, the derivation of EC does make sense only provided an asymptotic response level is observed at high exposure concentrations and, in the case of non-monotonic trends, requires the definition of a maximal amplitude of the response. Alternatively to EC, the Benchmark Dose (BMD) has been proposed in the field of toxicology for setting toxicity values. The BMD approach as mentioned in EFSA guidance proposes two options. The first one considers a x-fold change of the control response which seems hazardous sensitive to the signal level (if the control response is zero, so will be the x-fold change). The second option defines a critical response level accounting for the standard deviation of data (control response = SD). We will illustrate why this feature makes it more robust and usable whatever the concentration-response model.

WE369 Calculating the true ECx/LCx for non-linear models
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
ECx and LC50 are most frequently used endpoints for deriving Predicted No-Effect Concentration (PNEC) or Regulatory Accepted Concentration (RAC). ECx is defined as the concentration that shows x% effect compared to the control and LC50 is the concentration at which 50% mortality was observed. These definitions inherently assume the adverse effect at control is 0%. For example, in terms of mortality, the mortality at control should be 0% and when there is background mortality, Abbot’s correction has to be applied. In terms of plant growth, percentage of inhibition in growth compared to control is calculated to feed in the dose-response model. These approaches have bypassed the requirements to use the standardly used probit dose-response model by modifying the data to make the model assumptions valid. However, use of these approaches without caution can cause serious over- or under-estimation of ECx/LCx due to the ignorance of control variability, the improper use of binomial assumption behind the probit model, etc.
On the other hand, it is nowadays recommended that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem in practice because there is inconsistency in the definition of ECx in regulatory context and that in the software implementing these 3 or 4 parameter models procedures. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC50 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to the control as how it is defined. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data examples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE370 Review of Dose-Response Analyses in Regulatory Framework
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
Low effect EC values (EC10, EC20) derived from dose-response models have been recommended to replace NOECs in the pesticide regulatory context (e.g., new Regulation (EC) No. 1107/2009). The use of NOEC is often criticized because the standard power to detect NOECs in the absence of these approaches of null hypothesis testing can be very low due to high variability and small sample size. However, the concept and the limitations behind the various dose-response models have not been systematically addressed. There are ambiguities in the terminologies used such as linear and nonlinear dose-response models. When to use which model is not clear to practitioners. Practical difficulties in the implementation of the methodology lead to questions like what to do when there are no monotonic dose-response relationships, when ECx is superior to NOEC and when NOEC is more appropriate, why the confidence intervals are very broad in the range of low effect dose levels, and so on. In this study, we provide an in-depth review of the various dose-response models and associated assumptions and indications to answer these questions. Differences in which certain dose response model is more appropriate than others were described and illustrated using both real and simulated data examples. We show that the type of data, quantal, count or continuous are important to determine the error structure in the statistical model and the data characteristics provide inherently hints in the choice of dose-response model. The shared parameters and curve shapes between the so-called linear and non-linear models are clarified and the methods of these approaches without cautious are emphasized. We also identify a few common mistakes in practice due to wrong interpretation of dose-response analysis or wrong understanding of the software implementations. Potential improvements over the decision tree approaches proposed in the EFSA Guidance are discussed. The knowledge gaps related to non-monotonic dose-response relationships are also tackled. The connection between the multiple comparison procedure to derive NOEC and the model-based dose-response analysis are presented and hybrid approaches are discussed.
WE372  
Aquatic higher-tier exposure testing of pesticides - from complexity to simplicity  
G. Eck, E. Eschenbach, Eurofins Regulatory AG  
Flux exposure of pesticides is usually characterized by time-variable substance entries into water bodies resulting in complex exposure patterns which often significantly deviate from the constant exposure in standard ecotoxicity tests with aquatic organisms. As an appropriate risk refinement option higher-tier exposure testing is proposed in the current EFSA guidance document for aquatic risk assessments providing the possibility to define ecotoxicologically relevant test concentration patterns and meaningful link to FOCUS exposure modelling outputs. Studies designed to reflect realistic exposure often result in lower effects. However, FOCUS exposure patterns are frequently challenged in regard to their representativeness for the variety of possible field scenarios and hence are generally not accepted as valid refinement option by several EU Member States. Besides, it is often difficult to generalize various critical patterns of different FOCUS scenarios for incorporation into available data and information that is specific to a particular input variable (i.e., variability among toxicity values, distributional assumptions of AFs, etc.) instead of relying on a single value, as is necessary for deterministic methods. An added benefit of the PRA approach is increased transparency regarding the representativeness of a chemical's FOCUS. This work will demonstrate how PRA is used to calculate DNELs using trichloroethylene (TCE) as an example. The presentation will focus specifically on TCE's non-carcinogenic effects and incorporate the variability and uncertainties associated with dose-response modeling, physiologically-based pharmacokinetic modeling, assignment of AFs, and the choice of allowable risk level. The potential impacts of using PRA approaches to calculate DNELs will be discussed in relation to resulting risk-based exposure concentrations.

WE373  
Keeping it real: multidisciplinary approaches to aquatic risk assessment  
Aquat risk assessments for plant protection products (PPPs) can often be complex, comprising multiple crops, application rates, Member States (MSs) and therefore exposure scenarios. Critical to this process is that that hazard quotient (PEC/PNEC ratio) really represents and whether it is a realistic representation of the real risk. A number of assumptions and worst-case parameters are used within the Tier I risk assessment, both on the exposure (predicted exposure concentration; PEC) and the effect (predicted no effect concentration; PNEC) side of the equation. To maximise the realism within the risk assessment, it is therefore advantageous to take a multidisciplinary approach, involving specialists in environmental fate, exposure modelling, aquatic ecotoxicology testing and regulatory ecotoxicology when developing refinements for the risk assessment. By developing integrated solutions, it is possible to progress from theoretical to more practical assessments of environmental risk. For example, assessing the parameters used in standard exposure models and designing field fate studies to derive more realistic parameters; analysing the exposure profiles associated with the maximum predicted exposure concentration in surface water (PECsw) compared to the exposure conditions used in standard aquatic ecotoxicology studies and designing modified exposure studies to more accurately mimic these exposure profiles; etc. The aim of this poster is to illustrate how different disciplines can work together to challenge the default assumptions of standard aquatic risk assessment, thus enabling appropriate refinement options to be derived and together design optimal solutions that are closer to addressing the real risks, rather than the theoretical ones.

WE374  
Critical aspects of higher-tier laboratory exposure testing with different aquatic organisms  
G. Gonsior, Eurofins Agroscience Ecotoxic GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurofins Agroscience Ecotoxic GmbH / Aquatic Ecotoxicology  
Aquatic exposure testing. The aim is to higher-tier risk evaluations proposed in the current EFSA guidance document for aquatic risk assessments for plant protection products. It offers scope for risk refinement by defining ecotoxicologically relevant concentrations that might be less conservative than constant exposure scenarios realised in standard effect studies or to justify time-weighted average concentrations in context with chronic risk assessments. Higher-tier exposure testing can be applied with data and information that is specific to a particular exposure scenario as well as to a particular substance. The potential impacts of using PRA approaches to calculate DNELs will be discussed in relation to resulting risk-based exposure concentrations.

WE375  
Repeated pulsed exposure in a partial life cycle test with zebrafish: Keep it realistic!  
M. Teigeler, Fraunhofer IME / Ecotoxicology; B. Weber, D. Warnecke, RIFCON GmbH/Institut für Risikobewertungshilfsmittel  
Reefed exposure tests can be used to transfer more realism into standardised exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSA, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulsed exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, P0) were exposed to 4 pulsed applications at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by placing fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquaria of a total volume of 30 L were used and filled with a layer of artificial sediment to ensure stability of the test system throughout the 9-weeks test period. After one-time application on the bottom substrate water quality was periodically monitored. The evaluation of biological effects was based on mean measured as well as on area under the curve concentrations (AUC) of the test substance in order to be able to compare it to predicted environmental concentrations (PECp, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT99 values showed that the dissipation profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filial fish was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.

WE376  
Pulsed exposure of fish at sensitive life stages: The ‘worst case’ challenge.  
408

SETAC Europe 28th Annual Meeting Abstract Book
M. Teigeler, E. Eilebrecht, Fraunhofer IME / Ecotoxicology; A.J. Jones, DuPont Crop Protection / Institute of Environmental Toxicology

Refined exposure tests have become part of the regulation framework for plant protection products in the EU (EFSA Aquatic Guidance Document 2013). A pulse dose test can be used to address areas of risk that cannot be satisfied with the standard suite of aquatic toxicity tests. A pulse dose considers situations where the expected exposure over the field is significantly shorter than in the standard lab exposure tests. However, no challenge is given to cover exposure from multiple scenarios within one test. Therefore, the maximum exposure (peak) concentration, the number of peaks, the duration of the peaks, and the interval between peaks are considered to simulate a realistic profile covering a large number of scenarios. In this study, three different life stages of rainbow trout (Oncorhynchus mykiss) were exposed to different concentrations of the test chemical. To set these pulses as sharp as possible, the fishes were transferred from treatment vessels to untreated vessels at each time of pulse application. All vessels, including controls, were kept under flow through conditions. The concentrations of the test chemical were measured at start and end of each pulse event. Fertilised eggs, newly hatched fry and juveniles, already swimming up, were exposed. Glass aquaria with a total volume of 30 L were used. The evaluation of biological effects was based on mean measured concentrations measured for the test substance pulses and could be compared with the predicted environmental concentrations based on FOCUS modeling simulations. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible impairment of the sensitive stages. However, it was demonstrated that the performance of the life stages exposed was acceptable and conforms to quality criteria set by the test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the ‘worst case’ when a single laboratory exposure is unrealistic.

WE377

TIER2+: Developing the Tools for Future Risk Assessment - New Chronic Invertebrate Test Systems and the Application of Realistic Exposure Scenarios

A. Dubrunz, F. Kümlich, C. Lang, Eurofins Agroscience Services Ecotox GmbH / Aquatic Ecotoxicology

According to recent and proposed guidance of the European Food Safety Authority (EFSA) current aquatic toxicology test systems should be critically reviewed, addressed in regards of realistic (e.g. pulsed) exposure and complemented by establishing new test systems. To account for these challenges we will present data on a twofold strategy including A) test systems and B) exposure conditions/\textsuperscript{an} Un Experimental data of newly established (sub)chronic test systems, which are suitable meeting Tier 2 regulatory requirements, was collected. The evaluation of biological effects was based on evaluated include, for example, ostraecids, cyclopids, nematodes, oligochaetes and amphipods, with a focus upon experimental conditions, suitability of standard toxicity testing endpoints and experimental validity. Subsequently, data on selected test systems under flow through conditions simulating pulsed dose exposure scenarios will be given.

WE378

Optimisation of a chronic toxicity flow-through set up to investigate the adverse effects of chemicals to Daphnia magna

C. Beyer, IES Ltd; A. Peifer, Innovative Environmental Services IES Ltd; S. Höger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Jürgen, University of Appl. Sc. Northwestern Switzerland / Institute of Ecopreneurship; P. Corvini, University of Applied Sciences Northwestern Switzerland

Daphnids are playing an important role as representative or indicator species for aquatic invertebrates in the environmental risk assessment for plant protection products, chemicals and pharmaceuticals. To investigate chronic toxicity, semi-static Daphnia magna reproduction tests following Test Guideline OECD 211 have to be performed. So far this test design is also used for highly degradable substances, despite the fact that by using semi-static test design the exposure concentration of the parent test compound is decreasing and metabolic products are accumulating during the renewal intervals of 2–3 days. To ensure a steady exposure level, without added stress or higher dose of degradation products, the studies have to be performed in a flow-through system. We are presenting a new flow-through system for reproduction testing with Daphnia magna. The flow-through system may pose additional stress for the daphnids, since interval dosing of test medium is causing turbulences within the test vessels. To preclude that stress effects are given in the new flow-through system, a reproduction test with a hydrologically stable test substrate was carried out. This comparative test allowed studying stress parameters by comparing the effect level concentrations and the ECx values. Furthermore, a reproduction test with a fast degrading substance was tested to prove the ability of the new flow-through system to maintain a parent compound concentration above 80% throughout the test. In the comparative test both test systems showed the same dose-response-curves and gave the same No Observed Effect Concentration and Lowest Observed Effect Concentration for continuous exposure per survivor over 21 days. Thus it can be assumed that the new flow-through system does not cause additional stress on Daphnia magna in a 21-day reproduction test. In the reproduction test with a non-degrading test item, the new flow-through system could dose the test item concentrations very reliable and precisely (dosed concentrations between 98 and 105% of nominal). In this study, it was proven that the new flow-through system does not cause unacceptable additional stress for the daphnids and can be utilized for reproduction testing with Daphnia magna. All tests conducted in the flow-through system were valid in accordance with OECD Guideline 211. The dosing system is very precise and reliable and is capable to maintain a parent compound concentration above 80% for a test item with half-life of 5 hours.

WE379

Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage.

r. lanchez, C. DEUPUY, A. Jouand, Groupe SGS France; L. bertin, SGS Multilab / Ecotoxicology

Multi-trophic level bioassays are usually carried out to determine toxicity of effluents, chemicals, cosmetic ingredients, etc... Toxicity to species is different according to the compound type considered, therefore tests on plants, invertebrates and vertebrates should be conducted. On the other hand, vertebrate organism tests should be avoided when possible, including test on juvenile fish. Alternative methods need to be developed for juvenile fish testing, with equivalent predictability and sensitivity. Several alternative methods exist for freshwater studies but there is no standardized method available for seawater fish. This study is a first step in the evaluation of a marine fish embryo and larvae test as alternative to adult marine fish test OSPAR HOCNE guideline, for example. The embryo and larval stage sensitivity of turbot (Scophthalmus maximus) to differentiation and growth of the test substance (larvae) to reference substances were evaluated. To this purpose, within 72 hours post-fertilisation, the blastula stage eggs were exposed to reference substances separately. The effects of the toxicants on embryos and larvae were observed daily on a 10-days exposure period. For each reference substance and species, EC50 and mortality rate were calculated. To avoid vertebrate testing, results of this study were compared to published data. Several reference substances had a significant impact on survival of eggs and/or embryonic development. The sensitivity of the organisms is significantly different according to reference substances. Moreover, this test was used to evaluate toxicity of waste seawater samples in multi-trophic level bioassays (i.e. combination with single-species on algae, copepod and larval tests). Based on these results, marine fish embryo test appears as a credible alternative to juvenile fish testing. Therefore additional experiments will be conducted to validate this model.

WE380

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay

S. Pawlowski, M. Damann, S. Champ, BASF SE; M. Mathis, Port, Fort, Environmental Labs, Inc.

The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay - AMA) represents a Tier 1 ecotoxicity test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (NvKf) Xenopus laevis to different concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hind limb length (HLL), body length (snout to vent -SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid disruption. Recently, the relevance of hindlimb length (HLL) normalized to SVL as a marker of thyroid disruption has been questioned based on its relationship to the growth endpoints (SVL, weight) and the relationship between limb length and differentiation. To evaluate normalized HLL, the correlation between HLL and either SVL or body weight was evaluated in the controls from 10 independently performed AMA studies at study day (SD) 21. Eight of the 10 AMA studies did not have significant late stage development per OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100. For the 2 studies, data were censored to separate ≥ NF stage 60 from the >NF stage 60. Negative or no correlation between hindlimb length and SVL was found in 7 of the 8 studies examined without late stage development (r=0.315-0.275, 0.553). Negative or no correlation between body weight and body length of 6-8 weeks old turbot (Scophthalmus maximus) and hindlimb stage development (r=0.347-0.156, 0.429, 0.564). For the censored studies, correction between HLL and SVL or body weight was found in 1 of the 2 studies (r=0.452, 0.511). In each of the 10 studies, no asynchronous development was consistent with the absence histopathological findings in the control. The degree of HLL differentiation relative to other morphological markers of developmental stage does not determine if asynchronous development occurred. Since hindlimb differentiation is controlled by the thyroid axis during metamorphosis, it represents a more suitable endpoint in assessing potential thyroid disruption. To conclude, hindlimb differentiation, developmental stage and thyroid histopathology should be used in a weight-of-evidence based assessment of thyroid axis disruption. Normalized HLL should not be included in the assessment.

WE381

Acute toxicity test using Mediterranean fish species (Dicentrarchus labrax L., 1758): Inter calibration exercises towards standardized procedure
L. Mariani, CNR-RS/IBA, F. Savorelli, ARPA EMR; B. Di Lorenzo, ISPR, Institute for Environmental Protection and Research; F. De Luca Picone, ENEA; M. Francese, Shoreline, Trieste; E. Di Capua, Regional Agency for Environmental Protection, ARPA Toscana; G. Lacko, University of Genova; s. manzo, ENEA / SSPT-PROTER-BES; P. Masolo, Università degli Studi di Napoli Federico II; A. Mazzola, Regional Agency for Environmental Protection, ARPA Sicilia; D. Palazzi, Regional Agency for Environmental Protection, ARPA Emilia-Romagna; L. Jane, University of Genova; G. Sansone, Università Federico II Napoli; V. Bellaria, ISPR Institute for Environmental Protection and Research; G. Shril, Regional Agency for Environmental Protection, ARPA Toscana

The necessity to develop appropriate methods for the assessment of water quality and effluent toxicity was recognized by environment protection organisations and indicated by legislation. The OECD/EU Water Framework Directive (2000/60/EC) and the new Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006), both require data from ecotoxicological tests by using algae, crustaceans, and fishes. Some tests procedure have already standardised by organisations (ISO, OECD, USEPA, ASTM), but the freshwater test organisms were indicated more frequently than marine ones. In particular, the lack of specific acute toxicity methods on Mediterranean fish species have involved the adaptation of procedures available for freshwater fish (OECD, 202, 1992). In order to standardize the acute toxicity method for European sea bass (Dicentrarchus labrax L., 1758) larvae (species widespread in Mediterranean sea), two intercalibration exercises were conducted by 7 Italian laboratories, according to ISO/ECE 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories were instructed to use 24h-48h-s-trigger and the replicates test media to be used for acute and chronic tests (50-70 days-old) to the reference toxicant (Sodium Dodecyl Sulfate) concentrations: 6.31-3.98-2.51-1.58-1.00 mg/L and control. The LC50 (Trimmed Spearman-Karber method: TSK) mean valueranged from 2.93±0.52 mg/L to 3.98±0.99 mg/L to 24h; and from 2.90±0.50 mg/L to 3.87±0.13 mg/L to 48h, respectively. The intra and inter laboratory variability of the tests were verified and Z-values (2) were computed. Statistical analyses showed no significant differences in the data produced by most of the laboratories. The results indicate the standardization procedure is in advanced stage.

W3E82

Introduction of a New Dosing System for Chronic Fish Tests Conducted with Difficult Substances
S. Heger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Peither, J. Schreitmüller, Innovative Environmental Services IES Ltd

Chronic toxicity tests with fish are required for the risk assessment of many pharmaceuticals and chemicals (depending on their damage and characteristics of the chemicals). As chronic standard toxicity test the fish Early Life Stage (ELS) test following the OECD Guideline (GL 210) has to be conducted, in certain cases this test system can be extended to an OECD GL 229, 230, 234 or to a OECD GL 310. All these tests include the evaluation of sublethal effects on the test fish. This extension is recommended in case an influence of the substance towards the endocrine system (and finally the reproduction) cannot be excluded. The addi- tion of some “endocrine endpoints” avoids additional tests, which may be requested at a later stage from the competent authorities. Typically, for these chronic fish tests very low concentrations have to be tested and in many cases the substance to be tested can be classified as difficult according to the OECD criteria, for instance low water solubility, high toxicity to fish, volatility or degradation during 21-day test period. Based on the fish tests preferable a flow through test design is used and difficult test items with specific properties as described above request a highly sophisticated flow through test device to guarantee the success of the test. In cooperation with an external company specialized on providing flow through technique to science and industry, IES developed a new, highly flexible dosing system. This very flexible and computer controlled dosing device is a modular system which provides several new technical features for important steps during the test e.g., dosing of the test substance, preparation of the test media and distribution of the test medium to replicates. In this presentation several examples for the testing of difficult substances are shown and the advantages of this dosing system are explained. The biological and analytical results demonstrate that difficult test items can be successfully tested with all available test methods provided by the presented flexible flow through dosing system. Considering the increasing complexity of ecotoxicological tests and the methodical challenges during the testing of difficult substances, this presentation also intends to underline the importance of a continuous improvement of the technical setup for a successful performance of ecotoxicological test.

W3E83

Difficult Substances as Challenge for the Algal Growth Inhibition Test According to OECD Test Guideline 201
S. Heger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Dupont, J. Schreitmüller, Innovative Environmental Services IES Ltd

Photosynthetically active organisms such as green algae, blue green algae and diatoms are not only part of the risk assessment (RA) for plant protection products, but also standard test organisms for the RA for pharmaceuticals and chemicals (REACH). Especially chemicals as basic element for the synthesis of more complex products show a broad variety of characteristics from well water soluble, stable and non-toxic to hardly water soluble, unstable, volatile and toxic for water organisms. The group of chemicals with one or more of the latter characteristics is a challenge for the toxicity test with aquatic organisms. The OECD guidance document on aquatic toxicity testing of difficult substances and mixtures (23) provides some help for the “standard test fish” with difficulties to perform the test conducted, but due to the numberless combinations of characteristics of these difficult substances, some innovation is required to find the best test design for the individual chemicals. We show examples for the toxicity testing of difficult test items starting with the investigation of the characteristics of the test item in the respective test water (water solubility, stability in water, photolysis effect, adsorption, storage condition etc.). In this presentation, the added value for some specific test design to determine the toxicity, the testing itself and finally the choice of the most suitable evaluation method within the various possibilities of calculation and interpretation of the results. In this presentation we focus on the testing of algae, but many aspects can be transferred directly to acute and chronic toxicity testing with daphnids or fish. This is important as in daily business in most cases a package of aquatic studies has to be conducted and results shall be comparable. The presented working procedures demonstrate that every test item - independent from its characteristics - can be tested according to established OECD Test Guidelines, but in some cases extensive biological and chemical background and innovative capacity is required to find the best test design. To make it even more complicated, there are different ways to interpret the data and the most appropriate is clearly dependent on the required endpoints. The different possibilities are introduced and discussed as well.

W3E34

Activity based Collembola sampling may improve the data of field studies for regulatory purposes
J. Mack, A. Appeltauer, J. I illg, Eurofoins Agroscience Services Ectox GmbH; S. Knaebe, EAS Ectox GmbH / Ectox Field

Soil micro-arthropod field studies are carried out as part of the risk assessment of plant protection products. Those studies followed the proposed study design for soil organisms by Rönkbye et al. (2009). Soil cores are taken in the field and afterwards soil organisms are extracted from the soil using high gradient extraction. Until now little is known about vertical movements of collombola. Especially in long periods with high temperatures and low precipitation, a high number of collombolans might migrate in deeper soil layers as included in the standard sampling scenario of 5 - 10 cm soil cores. Therefore it might be useful to cover also deeper soil layers, which contain potentially more specimens at the sampling time. One activity based trapping method for soil microarthropods would be the slide traps which were presented at SETAC 2016 by Dehelean et al. 2016. Our poster will discuss possible advantages for the combination of soil core and slide trap sampling and will present first the results from the comparison of soil core and slide trap catches. Röm kbye, J., Schmelz, R., Knäbe, S., 2009: Field studies for the assessment of pesticides with soil mesofauna, in particular enchytraeids, mites and nematodes: Design and first results. Soil Organisms, 81: 237-264 - Stefan-Bogdan Dehelean et al., 2016 Stratification of soil arthropods in topsoil layers, SETAC Europe 26th Annual Meeting, Nantes, France

W3E85

New Technology evaluating Acartia tonsa as a biological model
S. Abreu, University of Aveiro / Dept. Biology & CESAM; S. M. Leandro, Polytechnic Institute of Leiria / MARE - Marine and Environmental Sciences Center, A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DEDI / IEETA

Copepods play an important ecological role on marine ecosystems and may act as a sentinel of environmental degradation resulting from direct or indirect human impacts. The copepod Acartia tonsa is a calanoid species with a worldwide distribution and relatively easy to maintain for several generations under captive conditions. These characteristics allow this species to be a potential biological model to be used on ecotoxicological studies or live food for larviculture. On of the bottlenecks for its massive utilization relies on the time consumption procedures associated to the technology D Counter constitutes an innovative approach, by the fact of turning the data harvesting process much more efficient and accurate, breaking the traditional, error-prone, human-based counting methodology. The obtained results for A. tonsa cultures indicate a high significant correlation between manual and automatic counting, constituting the first step for the use of this biological model on experimental studies.

W3E36

Solubility limits of lanthanides in standardized ecotoxicological media
Global Regulatory Affairs & Product Safety; A. Kamper, DHI; S. Gimeno, Firmenich / Product Safety and Regulatory Affairs

Limonene is a stereosomeric substance taking its name from lemon, which dominates the composition of the essential oils of citrus fruits. When synthesised as dipentene it is a racemate. However, in botanical sources it is present as the D- or L-enantiomer in Natural Complex Substances (NCSs) obtained at anything from traces in some plant extracts to over ninety percent in orange oil. These oils are commonly used as fragrance and flavour ingredients in a wide range of applications (cosmetic products, food manufacture, fragrance perfumery, botanical insecticide, household cleaning products, etc). Therefore, it is predominantly released back to the environment after use. The racemate and both D- and L-limonene received a harmonised classification under Annex VI of the EU C&L legislation as (Very toxic to aquatic life) and Aquatic chronic category 1: (Very toxic to aquatic life with long-lasting effects). Both classifications have a severe impact on storage, handling and transport requirements of limonene and the many (natural) complex substances and fragrance and flavour mixtures that contain even small amounts of it. The existing classification is a result of a limited data set notably for chronic endpoints. The chronic category 1 classification is extrapolated from the acute category 1 toxicity, log Kow > 4 and erroneously assumed not-rapid biodegradability of the substance. As limonene is a narcotic substance its Chronic 1 assignment was expected to be conservative. Due to doubts on the chronic classification and the consequences for labelling, storage, handling and transport, long term aquatic ecotoxicity studies were conducted to obtain a solid basis for the environmental classification. The chronic expectation was based on statistically significant differences are viewed in isolation from the rest of the available data from the study. The aim of this poster is to urge regulators to not just focus on statistically significant differences, but to take into account all available and relevant data to assess the biological relevance of any differences observed. At CEA we use a range of sampling methods to collect data on aquatic macroinvertebrates within our mesocosm studies, including emergence traps, coloniser and sweep nets. Each method samples a different set of species: emergence traps, colonisers and sweep nets. The sets overlap in the species they sample, but each is distinct. The data are collected on a range of different mesocosms and are used to assess the biological relevance of any differences observed. The mesocosms are designed to provide a realistic representation of the natural environment, allowing us to assess the effects of various substances on aquatic life. The data are used to inform regulatory decisions and to improve our understanding of the ecological impacts of substances. The poster presents an overview of the sampling methods used in our mesocosm studies and the biological relevance of the data collected.
used as medicinal products, e.g. gene therapies, into the environment is regulated by directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001. An integral part of the directive regulates the provision of information on the GMO and, based on this, the risk management with regard to the environmental effects of such releases. As regulated by this directive, a publicly accessible database (the “GMO Register” of the JOINT RESEARCH CENTER of the EC) has been established which contains information about applications for release under the Directive. As of 07.11.2016, there were 238 entries of medicinal GMOs in the “Summary Notification Information Format (SNIF). SNIFs are prepared as a summary document of the confidential environmental risk assessments (ERA) by the respective Sponsors of clinical trials in the EU and evaluated during the clinical trial application by the national competent authorities. This so-called, inter alia, information regarding the GMOs and the parental organism’s nature, release, environmental interactions, monitoring, waste treatment and emergency response plans. We strive to assess information concerning the environmental risk, derived measures and the overall standard of SNIFs concerning compliance with the regulatory requirements. To do so, we picked a homogeneous group of GMOs, namely gene modified Adenovirus, the most frequently used vector in gene therapy trials worldwide. Relevant information were entered into a database and categorized, applying unified vocabulary. Different challenges regarding the information available within the SNIFs were identified by analyzing the database: in several cases mandatory information was not available, e.g. monitoring plans, and in other cases the SNIF documents were misinterpreted, e.g. the connection between replication, dissemination and survivability was interpreted heterogeneous. The primary basis has been the recent environment and used by the EU (TC NES) from the early 2000’s enlarging the protection goal to any environment. The criteria became applicable to any chemical produced over 10 TPA when REACH regulation came into force, thus, treating chemicals as a homogeneous group. Interestingly, the criteria were originally defined by using data from a set of chemicals known as highly hazardous for the environment. Such compounds (e.g. polychlorinated aromatic compounds) were non-toxic and hydrophobic while the chemical space is much more diverse. In other words, a BCF value of 2000 may be a good cut-off for chemicals which are both highly hydrophobic and slowly metabolised to amplify the achievement along a food chain, and Whether a chronic value can be established based on its MoA. Significant scientific progress has been made in the field of aquatic toxicity testing of difficult chemicals, evaluation and interpretation of ecotoxicological data since the PBT/vPvB criteria -off values for P and vP in terms of empirical and interpretation of data, information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.

WE391
PBT evaluation 20 years on: is it time to reconsider the technical progress made in risk assessment methodology?

P. Thomas, C. Durou, CEHTRA SAS / -

In the EU, the ecotoxicological dataset for a chemical is used for the purposes of prospective risk assessment (PRA) and of PBT assessment. While the PRA aims at determining the use conditions and risk management for which the environment is safe, the PBT assessment aims at identifying chemical for which effects on the long-term are considered unpredictable and that environmental exposure is difficult to reverse. The scope of this poster is to discuss, in the light of technical and scientific progress: For which PBT-Like and certain PBT chemical, PRA can now be carried out. The justification of the numerical criteria behind the identification of PBT vs vPvB is essentially based on the idea that: Assessing accurately a chemical’s potential to amplify along the food chain, and Whether a chronic value can be established based on its MoA. Significant scientific progress has been made in the field of aquatic toxicity testing of difficult chemicals, evaluation and interpretation of ecotoxicological data since the PBT/vPvB criteria were originally designated. The numerical criteria were established in the late 1990s by OSPAR. Although the primary basis has been the marine environment and used by the EU (TC NES) from the early 2000’s enlarging the protection goal to any environment. The criteria became applicable to any chemical produced over 10 TPA when REACH regulation came into force, thus, treating chemicals as a homogeneous group. Interestingly, the criteria were originally defined by using data from a set of chemicals known as highly hazardous for the environment. Such compounds (e.g. polychlorinated aromatic compounds) were non-toxic and hydrophobic while the chemical space is much more diverse. In other words, a BCF value of 2000 may be a good cut-off for chemicals which are both highly hydrophobic and slowly metabolised to amplify the achievement along a food chain, and may be of limited meaning for other chemical classes. In the US, B is defined as a BCF of >5000 which is the vB criteria in the EU while perhaps the only -off values for P and vP in terms of empirical and interpretation of data, information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.
registration process for plant protection products. When Regulation (EC) No. 1107/2009 came into force, adherence to the SANCO/30299/rev 4. Guidelines became obligatory. This has resulted in serious implications for the registration process because ecotoxicological studies may well now be rejected on the basis of inadequate analytical methodology or incomplete analytical data although the studies have previously been accepted. Here we give an overview of current requirements and provide a checklist that can be used to evaluate analytical methods in ecotoxicological studies.

WE396 A new pulsed-exposure early life stage test design for rainbow trout on an insecticide. Refining OECD Guideline 210 to meet the needs of EFDA Aquatic Guidance 2013

C.S. Rasmussen, AgroChemex Environmental Ltd / School of Biomedical and Biological Sciences; C. Gamblin, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco

Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. EFDA Aquatic Guidance (2013) allows aquatic toxicity studies to be modified so the exposure-profile (peak-height, pulse-duration, number of pulses) is comparable to the worst-case predicted field-exposure. In the present study on a synthetic pyrethroid (SP) insecticide, a novel method was developed to simultaneously assess effects on 3 early-life stages of rainbow trout. The TG 210 design was modified to incorporate a worst-case time-variable exposure profile in tanks containing a 10 mm sediment layer and stainless steel mesh barrier to allow water movement but prevent fish disturbing the sediment. Life stages used were newly fertilised 'eggs', 'alevins' (non-feeding larvae) and free-feeding 'swim-up' fry. To ensure physical separation of the 3 life stages within the tank, eggs and alevins were each held in a glass incubation tube with a mesh base. A control group plus 5 concentrations were used. To start, each group had 4 replicate tanks each with 50 eggs, 20 alevins and 20 swim-up fry. The 20 hour static exposure phases on Days 0 and 14. The study duration for organisms starting as 'eggs', 'alevins' and 'swim-up' fry was 72, 45 and 31 days respectively. This allowed for the assessment of effects over a period including at least 2 weeks of growth after initiation of free-feeding for each of the 3 life stages. Standard end points were assessed including hatch success, survival, growth and clinical signs (e.g. loss of equilibrium and coordination). To assess the potential neurotoxic action feeding behaviour was categorised as active, passive and not feeding. This refined-exposure study showed that 3 critical life stages of fish can be tested simultaneously, whilst complying with the fundamental elements of TG 210. Control hatch and survival rates were both >95%. The design allowed the direct comparison of the sensitivity of each life stage to a range of exposure profiles. Free-feeding 'swim-up' fry was the most sensitive exposed life stage, based on clinical signs, feeding and slightly reduced growth. Swim-up of exposed alevins was delayed at high treatment levels. Exposed eggs were unaffected.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a monocentric point of view (P)

WE397 Dissolution of Different Silica Nanoparticles in Aqueous Matrices


Since centuries, silica (SiO2) is used in large scale industrial applications, such as cement manufacture or glass production. In these applications, SiO2 is used in its bulk form. Recently, SiO2 nanoparticulate form has broadened the range of applications, both in large scale, e.g. as anti-cake agent in food industry, or owing to its abrasive effect in cosmetics; and in small scale, for the production of biosensors, swim-up fry. There were 22 hour static phases [1]. The use of silica nanoparticles (SiO2-NPs) as a delivery vehicle for molecules in plants has broadened the range of applications, this knowledge will also allow to produce more environmentally friendly products. Here, we present the results of a method development to quantify the dissolution of different SiO2-NPs in aqueous media in order to determine the dissolution kinetics. This method relies on the use of inductively coupled plasma optical emission spectroscopy (ICP-OES) for the quantification and the parallel characteristic of the particles by transmission electron microscopy (TEM) and dynamic light scattering (DLS). A simple setup based on dialysis membranes, and a sampling protocol are in the process of being established. The first results indicate that is possible to detect the dissolved fraction of SiO2-NPs roughly 60 nm in diameter within about one day. Long-term dissolution experiments will be performed in the coming months to determine the dissolution kinetics more precisely. This setup will serve as a tool to assess the behavior of SiO2-NPs in environmental media. [1] Bark TK, Sahu B, Swain V. 2008. Nanosilica—from medicine to pest control. Parasitology Research. 103:253, [2] Torney F, Trewyn BG, Lin VSY, Wang K. 2007. Mesoporous silica nanoparticles deliver DNA and chemicals into plants. Nature Nanotechnology. 2:295. Acknowledgement - The authors thank the Swiss National Science Foundation (project 168187) and the Adolphe Merkle Foundation for the support and funding of the study, and Laura Rodriguez-Lorenzo for her precious advice and suggestions.

WE398 Occurrence of fullerenes aggregates in Mediterranean rivers: Two cases of study

J. Sanchis, IDAEA-CSIC / Water and Soil Quality Research Group; R. Milaic, Jozef Stefan Institute (JSI) / Department of Environmental Sciences; M. Farre, IDAEA-CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry

Fullerenes are carbon nanomaterials that have many potential applications in nanotechnology and that can be generated in some combustion processes. Since their environmental effects and behaviour are uncertain, fullerenes are considered emerging contaminants and during the last years they have been included in some regulative studies. Nevertheless, the occurrence, fate and behaviour of fullerenes in the environment and water systems has not been thoroughly studied. Here, we report the presence of fullerenes in Mediterranean waters. In order to assess the environmental risk of fullerenes it is important to enlarge the dataset and to characterize the concentrations of these nanomaterials in different rivers.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a monocentric point of view (P)

WE399 Occurrence, fate and behaviour of fullerenes in the environment

M. Farre, IDAEA-CSIC / Environmental Chemistry; J. Sanchis, IDAEA-CSIC / Water and Soil Quality Research Group; Y. Aminot, University of Plymouth; E. Abad, IDAEA-CSIC; A.N. Jha, Plymouth University / Biological Sciences; J.W. Readman, University of Plymouth / Biogeochemistry Research Centre; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry

The occurrence, fate and behaviour of carbon nanomaterials in the aquatic environment are dominated by their functionalization, association with organic material and aggregation behaviour. In particular, the degradation of fullerene aggregates in the aquatic environment is a primary influence on their mobility, sorption potential and toxicity. In this presentation, a summary of the occurrence of fullerenes in environmental matrices performed in different studies of our group will be presented. The analytical approach to investigate seven fullerenes (C60, C70, C84, C96, pyrrolidine tris-fullerene, [6,6]-phenyl C4 fulleropyrrolidine, [6,6]-phenyl C6b butyric acid methyl ester, [6,6]-thienyl C4 butyric acid methyl ester, C60 pyridine tris-acid ethyl ester and [6,6]-phenyl C6b butyric acid methyl ester) in waters, soils and sediments combines an ultrasound-assisted solid phase extraction (UAE) and chromatography coupled to a high-resolution mass spectrometer (HRMS) using atmospheric pressure photo ionisation (APPI) in negative ion mode. Main results of these studies showed levels of pg/mg to ng/mg in atmospheric aerosols, pg/g-ng/g in soil and pg/l-ng/l in river waters. The composition of different fullerenes including pristine fullerenes (C60 and C70) and functionalized ones from the engineered origin will be discussed. In addition, different degradation studies of fullerenes in water suspensions emulating different environmental conditions and during a wastewater treatment will be presented. Degradation studies have been carried out under controlled conditions of salinity, the humic substances content, the pH and the sunlight irradiation. The results of degradation studies will show that up to ten transformation products are produced, including epoxides and dimers. Finally, the kinetics of generation of each transformation product will be as well presented.
The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

M. Surrette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering

The colloidal stability of engineered nanomaterials (ENMs) within aquatic environments has been shown to be influenced by attachment of cell wall material. Our research using simplified, synthetic mediums has demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is unknown whether this coating will continue to dictate particle stability when the ENM is dispersed within a complex, natural medium. Instead, it has been suggested that the “eco-corona” acquired by the ENM via interactions with the surrounding environment will govern ENM stability. This implies that within these mediums, engineered surface coatings will have a negligible impact upon ENM stability. The aim of this research was to investigate this subject further and determine whether an ENM’s engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium.

When samples of a local freshwater river to represent a complex, natural medium, a suite of batch experiments were conducted. Each batch was dosed with a single model ENM, which included 12-15 nm gold-core nanoparticles (AuNPs) with different surface coatings (e.g., diverse surface charges, stabilization mechanisms). Aliquots were collected from each batch over time, immediately centrifuged to remove large particles/aggregates, and the supernatant collected for analysis via ICP-OES. From this, the concentration of unaggregated AuNPs remaining in the supernatant over time was measured, as well as the apparent attachment efficiency of AuNPs to the various model ENMs. As was expected, the ENMs that maintained a positive surface charge over the course of the experiment, showed the lowest attachment efficiency. More importantly, however, was that both the neutral and negatively-charged ENMs remained stable throughout the duration of the experiment (8 hrs.). This suggests that the surrounding environment did not affect the stability of these ENMs and demonstrates that ENM stability is influenced by the engineered surface coating, even after interacting with a complex, natural medium.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

Y. Gokmen, University of Strathclyde / Civil and Environmental Engineering; R. Skuce, Scottish Water Horizons Ltd; C. Knapp, V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

The rapid evolution of nanotechnology poses a unique and significant challenge for wastewater treatment plants (WWTPs). Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical devices, drugs, etc. The interactions changes in WWTPs. As the incoming towns, we see increasing input of ENPs into WWTPs. Therefore the increased use and potential toxicity of ENPs poses a challenge for WWTPs due to their potential harmful effects towards activated sludge. The extent to which WWTPs can remove ENPs from the sewage must also be explored, to determine not only likely outflow into receiving waters but also accumulation within the activated sludge itself. To this end we focussed our studies on activated sludge treatment, as the majority of ENPs can remain in wastewater stream throughout preliminary and primary stages. We investigated a range of ENP digestion and analysis protocols to determine the most reliable procedure for ENP analysis from activated sludge. From this, we developed an analytical method involving H₂SO₄-HNO₃, microwave assisted digestion coupled with ICP-OES to measure ENP concentrations. Following this, using laboratory microcosms we assessed the kinetics of ENP removal by activated sludge. The kinetic design we adopted provided different ENPs which have been widely used in new applications in several sectors such as personal care products, biomedicine and catalysis. NP-containing wastes discharged in aquatic systems...
have produced undesirable effects in many marine organisms. Marine phytoplankton is vital in marine ecosystems, as microalgae are at the bottom of the food web and, therefore, any change in microalgae population will have an important impact into the rest of food web. The direct mechanism of NPs toxicity is the physical damage in cell membrane through adsorption of NPs onto the cell wall leading to NPs uptake, bioaccumulation and toxicity in different organselles. Therefore, the hypothesis of the work is that microalgae lacking of cell wall will be more susceptible to different effects of NPs than those microalgae with a typical cell wall. To test this hypothesis two microalgae species, Dunaliella salina, lacking cell wall, and Chlorarella autotrophica, with a typical cellulosic cell wall were chosen. Species were exposed to ionic (AgNO₃ and Ce(NO₃)₃) and NPs (Ag NPs and CeO₂ NPs) forms of Ag and Ce over 72 h and the following responses were assessed: cell density, cell viability, cell size, cell complexity, autofluorescence of chlorophyll a, active chlorophyll, effective quantum yield of photosystem II and reactive oxygen species (ROS). Metals in both forms (NPs and ionic) caused negative effects in cell division, inherent cell properties and physiological mechanisms of both microalgae. The general trend was a decrease in active chlorophyll, effective quantum yield of PSII and cell density and an increase in cell complexity and percentage of intracellular ROS. For both microalgae species, Ag was more toxic than Ce and ionic forms of both metals were more toxic than NPs. Contrarily to our hypothesis, D. salina, despite not having a cell wall, showed to be less sensitive to metals than C. autotrophica. Therefore, the cell wall of C. autotrophica seemed not to suppose higher protection preventing toxicity of NPs. The higher resistance of D. salina against the metals and metallic NPs tested might be related to: (i) its ability to stock-dispersion, the measured z-averages ranged from 600 nm (Cu(II)-27Ni) up to 8 µm (HKUST), ZnCPO, FeBTC-JM-AR and CPO-27-Ni are investigated in relevant environmental test media. Furthermore, we study the dissolution of metals and other elements from NPMs in test media, and their contribution to the observed effects on R. subcapitata. Particle size measurements showed that the NPMs have a primary particle size between 200 nm and several micrometres. In freshly sonicated stock dispersions, the measured z-averages ranged from 600 nm (Cu(II)-27Ni) up to 8 µm (HKUST), ZnCPO and CPO-27-Ni had the most negative zeta-potential of -25 and -20 mV respectively, with Al(OH) fumarate and FeBTC-JM-AR forming a positive surface charge. Uio-66-COOH and HKUST had very weak surface potentials, which was also reflected in their instability in the stock and exposure media. In a first dissolution study, 5 out of 6 materials (100 mg/L) caused an increase in specific dissolved metals or elements in the exposure media, both in relevant environmental concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric morphometric approach was used to assess the deformities in chironomid larvae exposed to nanoparticles. Geometric Morphometrics revealed the tendency of the mentum teeth to narrow and elongate and the mandibles to widen and thinen the first inner tooth, with a rise in the TiO₂ concentration. The present study revealed most suitable endpoints in the case of TiO₂ nanoparticles (in the form of human white food colorant E171) toxicity on the freshwater midge Chironomus tentans. The safety and consequences of the intake of this form of E171 TiO₂ for human health have been recently reconsidered. The experimental design was constructed for the sediment dwelling chironomid larva according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg E171 TiO₂ per kg were set as the minimum and maximum concentrations. Sublethal effects on C. tentans larvae at environmentally relevant concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric morphometric approach was used to assess the deformities in chironomid larvae exposed to nanoparticles. Geometric Morphometrics revealed the tendency of the mentum teeth to narrow and elongate and the mandibles to widen and thinen the first inner tooth, with a rise in the TiO₂ concentration. The present study revealed most suitable endpoints in the case of TiO₂ nanoparticles contamination in freshwaters, using Chironomus tentans as a bioindicator. The results show that morphological changes of C. tentans could be used as an endpoint in nano-TiO₂ monitoring together with geometric morphometry.

WE407 Toxicity of TiO₂ nanoparticles to freshwater chironomids - pointing out the relevant endpoints

D. Šavić Zdravković, Faculty of Sciences and Mathematics, University of Niš / Department of Biology and Ecology; B. Jovanović, Iowa State University / Natural Resource Ecology and Management; A. Đurđević, J. Stanković, Faculty of Science and Mathematics, University of Niš / Department of Biology and Ecology; D. Milošević, Faculty of Sciences and Mathematics, University of Niš / Department of Biology and Ecology

In the environment, nanoparticles are present in a number of chemical forms, exhibiting specific interactions, mobility, biological availability and potential toxicity. Both ecotoxicologists and pathologists have expressed their concerns regarding the potential negative effects of nanomaterials in live systems and the environment. The present study was carried out in order to assess the influence of TiO₂ nanoparticles (in the form of human white food colorant E171) toxicity on the freshwater midge Chironomus tentans. The safety and consequences of the intake of this form of E171 TiO₂ for human health have been recently reconsidered. The experimental design was constructed for the sediment dwelling chironomid larva according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg of E171 TiO₂ per kg were set as the minimum and maximum concentrations. Sublethal effects on Chironomus tentans larvae at environmentally relevant concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric morphometric approach was used to assess the deformities in chironomid larvae exposed to nanoparticles. Geometric Morphometrics revealed the tendency of the mentum teeth to narrow and elongate and the mandibles to widen and thinen the first inner tooth, with a rise in the TiO₂ concentration. The present study revealed most suitable endpoints in the case of TiO₂ nanoparticles contamination in freshwaters, using Chironomus tentans as a bioindicator. The results show that morphological changes of C. tentans could be used as an endpoint in nano-TiO₂ monitoring together with geometric morphometry.

WE408 Multigenerational exposure of the nematode C. elegans to Silver Nanoparticles at the expense of oxidative stress defence mechanisms

L. Rossbach, Norwegian University of Life Sciences UMB / IMV; E. Maremonti, Norwegian University of Life Sciences UMB; M. Jørgensen, Norwegian University of Life Sciences; D. Oughton, Norwegian Public Roads Administration / Centre for Environmental Radioactivity (CERAD CoE); D.A. Brede, Norwegian University of Life Sciences / Centre for Environmental Radioactivity

Adverse effects of Ag are widely known, with effects ranging from oxidative stress, DNA damage and genetic inhibition to whole-body effects such as growth and reproduction. Most toxicological studies, however, only cover a limited timescale of the organism’s life-stage, rather than the whole lifespan, or even across generation. Therefore, knowledge on multigenerational effects is lacking. The current study was conducted in order to determine whether the six generational exposure to sub-lethal concentrations of either ionic or nanoparticulate silver (AgNP) could induce alterations in sensitivity to Ag exposure using the nematode C. elegans as a model. Further, changes in susceptibility to other metals and the role of ROS as well as metabolic changes were investigated. Exposure to sub-lethal concentrations revealed increased susceptibility to toxic Ag, while reactions in the aqueous phase, and some NPs (e.g., TiO₂-NPs) also have photocactivity. Aqueous-phase interactions between PAHs and TiO₂-NPs are of interest because they are becoming more environmentally relevant (i.e., as NPs are increasingly released into the environment), and because investigations of sorption/desorption processes, in the context of photoactivation, can provide important new information on photochemistry of both PAHs and NPs. Previous work conducted by our research group has found that some of PAHs onto photo-active NPs promotes photo-catalysis of PAHs thus altering PAHs bioavailability and toxicity under UV-A radiation. In these experiments, bioavailability (cytochrome P4501A cyplA gene expression in larval zebrafish) is used as an analytical tool to demonstrate sorption of anthracene and benzo(a)pyrene to NPs in water. Our objective is to investigate PAH/TiO₂-NP sorption under UV-A and light-promoted decomposition of PAH decomposition by photosensitizing polycyclic aromatic hydrocarbons (OPAHs) and their bioactivity. Various combinations of PAH/TiO₂-NP preparations will be exposed to UVA, and changes in gene expression of genes involved in Phase I metabolism (cytochrome P450 cyplA and cyplB) and Phase II metabolism (gst, epox; gsh; and epoxide hydrolases epbl and ephbl2) in early life stages of zebrafish will be assessed. The exploitation of biological responses in PAH-TiO₂-NP interactions is expected to provide novel insights into these processes tested directly within the environmentally relevant aqueous phase.
AgNPs tolerance increased. Results show that adaptation development may occur after just a few generations. Subsequent exposure to paraquat, a known ROS inducer, indicated the involvement of ROS defense mechanisms. Therefore, changes in glutathione redox potential and sod-1 gene expression were measured, employing the genetically encoded fluorescent biosensors Gpxr1-gfpF2 and, the reporter strain Sod-1::gfp, respectively. Further, effects of the AgNPs on the central metabolism and implications on energy production are investigated by measuring the respiration of log-phase cultures of AgNPs-treated and PE255. Findings of this study will aid to further improve the understanding of the toxicity of nanoparticles, as well as contribute to our knowledge about the behavior of C. elegans in response to toxics. Acknowledgements: Karl Andreas Jensen and Sofridh Lohne. This work was supported by the Norwegian Research Council funded NanoCharm (221391/E40) and NorNanoReg (239199) projects, and the EU NANOREG project grant agreement n° 310584.

**WE409**
Effect of silver nanoparticles layer on soil surface to terrestrial species
J. Kwak, S. Nam, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

With developing nanotechnology, uses and release of engineered nanomaterials are increasing. Landfill of biosolid after wastewater treatment is considered as one of indirect exposure sources of nanomaterials. This study focused on the simulation of exposure scenarios of nanomaterials landfills, and set the aim to investigate different toxic effects derived from different scenarios. Silver nanoparticles (AgNPs) were selected as test nanomaterials. Through 4 different exposure scenarios, toxic effects were not revealed yet. Yet, expanded polystyrene (EPS), one of common marine plastics may have some toxic effects in terms of the diversity of bacteria that colonize MS, it was less than the natural variability observed for the microbial communities that colonized non-exposed (no nanoparticles) MS particles. Therefore, while nano-plastics may have some toxic effects, their toxicity might be less than in the absence of nano-plastics. Analysis statistic, however, did not provide substantive evidence to suggest that these differences and variabilities were significant. Therefore, while nano-plastics may have some minor effect in terms of the diversity of bacteria that colonize MS, it was less than the natural variability observed for the microbial communities that colonized non-exposed (no nanoparticles) MS particles. These findings suggest that plastic debris introduced from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres.

**WE410**
Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight
Y. Song, Korea Institute of Ocean Science and Technology; W. Shin, S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group; S. Eo, Korea Institute of Ocean Science and Technology

Production of nano- and micro-sized plastics through weathering of plastic surface by photo-oxidation was regarded as one of major input sources of secondary nano- and microplastics. Its fragmentation process according to exposure duration and sunlight intensity to which the nano- and microplastic particles were exposed (no nano- and microplastics introduced some minor effect in terms of the diversity of bacteria that colonize MS, it was less than the natural variability observed for the microbial communities that colonized non-exposed (no nanoparticles) MS particles. Therefore, while nano-plastics may have some minor effect in terms of the diversity of bacteria that colonize MS, it was less than the natural variability observed for the microbial communities that colonized non-exposed (no nanoparticles) MS particles. These findings suggest that plastic debris introduced from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres.

**WE411**
Effects of nano-plastics on natural marine aggregates and their associated microbial communities
S. Summers, SCELSE Nanyang Technological University / SCELSE; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society; T. Gutierrez, Heriot Watt University / School of Life Sciences

Plastic debris in the marine environment is of particular interest, as the issue is one on a truly global scale. The ubiquitous presence of micron sized plastic particles and the knowledge that these will break down into ever smaller, nanometre sized particles, has resulted in a surge of recent research into nano-plastics. However, the difficulty in detection of nano-plastics has made it difficult to predict the specific risks involved in their presence within a marine environment. We recently showed that nano-plastics are readily incorporated into marine snow (MS) particles as mediated by ‘sticky’ polymeric substances and other particulates. MS particles are described as a heterogeneous matrix composed of polymeric substances, such as EPS, faecal pellets, invertebrate casts and microorganisms. It is therefore expected that the fragmentation of nano-plastics with MS should include plastics to the total pool of suspended particulates of the marine snow. Studies on the impacts of this pool of MS-associated nano-plastics, however, are lacking, including the microorganisms found colonizing these particles. Since microorganisms, in particular bacteria, are major colonizers of MS, we hypothesized this would also be the case for MS-associated nano-plastic particles. To assess this, we generated MS associated nano-plastic particles by collecting them from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres.

**WE412**
Tracking nanoplastics in marine bivalves at environmentally realistic concentrations
M. AL SJD CHEUKH, University of Plymouth / Marine sciences and engineering; J. S. Rowland, University of Plymouth / School of Geography Earth and Environmental; K. Stevenson, Charles River; C. Roleau, Pesches et Oceans Canada; T. B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society; R. C. Thompson, Plymouth University / School of Marine Science and Engineering

Awareness campaigns on plastic pollution in oceans are backed by governments worldwide with recent initiatives to ban plastic products such as micro-beads from cosmetics or single-use plastic bags. The fragmentation, the persistence and the production of plastic particles (micro < 1mm, MPs, to nano-size < 1µm, NPs) are among the most prominent environmental issues faced by government environmental agencies. The environmental challenge that is expected to be able to provide the best evidence to support plastic debris that is tissue distribution if ingested by an organism. Therefore, the success of environmental plastic monitoring programs will ultimately depend on the reliability of extraction and detection of plastic particles in tissues of diverse organisms. However, most exposure experiments performed with plastic particles are carried out with unlikely high doses of particles, typically above 1 mg/L while the environmental concentration is expected to be at parts per trillion. A major influence in altering the bacterial communities associated with MS particles.

**WE413**
Plastics: does size matter? Impact of environmentally relevant nanoparticles identified in the Nordic environment
T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; I. Nerland Bråte, Norwegian Institute for Water Research NIVA; S. Brooks, NIVA / Ecotoxicology and Risk Assessment; A. Macken, NIVA / marine pollution; D. Edsvoll, Norwegian Institute for Water Research NIVA / Ecotoxicology and Risk Assessment; M. Reid, Norwegian Institute for Water Research NIVA / Environmental Chemistry Section; A. Georgantzopoulou, Norwegian Institute for Water Research NIVA

Plastic pollution is a widespread concern worldwide. Substantial amounts of plastics are produced and discharged into the environment every year, which will potentially impact aquatic ecosystems and consequently aquatic organisms. Plastic in the aquatic environment can undergo mechanical, chemical and biological degradation that can give rise to the formation of nanoplastics (NPs) which can be denominated as micro- (< 1 mm) or nano-plastics (< 100 nm) depending on size range. Microplastics are ingested by a range of aquatic organisms and this ingestion might cause adverse biological effects, however less research has been conducted on their smaller counterparts, nanoplastics (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their toxic potential towards aquatic organisms. Depending on surface characteristics and interactions with the surrounding environment. Nonetheless, their presence in the environment and any toxic mechanisms are, to a large extent, unknown. In this study, the impact of environmentally relevant plastics identified in Norwegian
environmental samples will be evaluated at the nanoscale in three key marine species, the cryptophyte algae Rhodomonas sp., the harpacticoid copepod Tisbe battagliai and the blue mussel Mytilus edulis and compared to its microscale counterpart. The uptake, accumulation and elimination kinetics of NPLs in the three species will be evaluated under ecologically relevant conditions, as well as their potential transfer along the aquatic food chain. Furthermore, the acute and sublethal ecotoxicological effects of both plastic sizes will be investigated at individual, cellular and molecular levels using different biological endpoints. With the results obtained in this study we aim to discuss the differences in uptake, accumulation and biological responses between different sized plastics identified in the Nordic environment, and consequently bridge the current knowledge gap on the assessment of their potential hazardous effects in marine biota.

WE414 Ecotoxicity of engineered nanomaterials in relation to ecosystem complexity and functioning

W. Peijnenburg, RIVM / Center for Safety of Substances and Products; Y. Zhai, CML Leiden University; M.G. Vijver, CML Leiden University / Conservation Biology Laboratory

Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposition are threatening the aquatic and terrestrial ecosystem. While important knowledge has been gained about the uptake of ENMs on cultured invertebrate and microbial species based on simplified microcosm and mesocosm model systems, extrapolation of results of these short-term tests to the complex and dynamic conditions of the natural environment indicates that risk assessment of ENMs should be conducted in an integrated multi-dimensional perspective. For instance, relatively simple studies on uptake and accumulation of ENMs by invertebrate species need to further investigate the perturbation caused by interactions between the intestinal microbiome and the host. Also, the link between microorganisms and invertebrates in a detrital food web should be included for a systematically evaluation of ENMs toxicity.

WE415 Development of rapid reacting automatic mobile lab responding chemical accident of aquatic environment in Korea

H. PARK, Hanyang Univ. / Regulatory Chemical Analysis & Risk assessment Center; S. ok, Kitech / Regulatory Chemical Analysis & Risk assessment Center; M. Song, J. Ra, Korea Institute of Industrial Technology

Most of available mobile lab developed and operated in Korea are air quality monitoring system and there is no rapid reacting mobile lab responding chemical accident of aquatic environment in Korea. We designed rapid reacting mobile lab with two major factors, 24hr operating and rapid starting within 1hr after arrival. We also considered system stability during transportation and accessibility to target river or stream, where we collected vibration information of a vehicle by exposure to vibration during transportation and raised spot of a road and reduced speed. Vibration vulnerability assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse accessibility characteristic to river by conducting sampling at the selecting sampling point. Lastly, we adopted special air-conditioning system to control the system contamination from exposure to vaporized chemicals at the accident location. We adopted dual power supply system with 5.5kWh main battery and 24hr operation capacity with 2hr supplementary battery system of 10kWh assisting and initiating the system on arrival and in between generator exchange. Vibration testing shakers are established with vibration information collected. Activated carbon proved to be most effective to control our target chemicals, which was composed onto COMBI type filter. These findings will be modulated and structured to maximize system stability.

[keyword] chemical accident, mobile lab, rapid monitoring system

WE416 Trophic Interactions in the Bioaccumulation and Depuration of Silver in Fish from a Lake Dosed with Nanosilver

C.D. Metcalfe, Trent University / Water Quality Centre; V.V. Yargeau, McGill University / Chemical Enneering; K. Newman, J.D. Martin, Trent University / Water Quality Centre

Bench-scale tests have shown that silver (Ag) accumulates in the tissues of fish exposed to silver nanoparticles (AgNPs). However, these experiments cannot replicate the complex bioecological processes and trophic interactions found in natural aquatic ecosystems. This study was conducted as part of whole lake addition project in which a total of 15 kg of AgNPs was added over two ice-free field seasons to a small lake (i.e. Lake 222) in the Experimental Lakes Area in Canada. Both yellow perch (Perca flavescens) and northern pike (Esocus lucius) accumulated Ag in their tissues. The greatest bioaccumulation was observed in the liver tissues of pike, and a significant correlation was observed in pike and perch between the concentration observed in liver of 5.1 µg/g wet weight. In perch, the highest concentrations of Ag were observed in gill tissue. Monitoring in the lake using passive sampling devices and single particle ICP-MS confirmed that Ag nanoparticles were present in the water column and that Ag was distributed throughout the lake at estimated concentrations in the range of 1-11 µg/L. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through uptake into the gill, whereas pike probably accumulated Ag from the diet. The transfer of Ag from forage fish to piscivorous fish can occur in natural lake ecosystems, leading to concentrations in some tissues that are orders of magnitude greater than the concentrations in water.

WE417 Hepatotoxicity of iron oxide (magnetite) nanoparticles in the guppy Poecilia reticulata

G. Qualhalo, Federal University of Goias / Department of Morphology; T.L. Rocha, University of Algarve / CIMA; S.M. Sabia-Moraes, Federal University of Goias / Department of Morphology

Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomedication, its ecotoxic effects to aquatic organism remains unclear. In this study, the hepatotoxic effects induced by citrate-functionalized IONPs at environmentally relevant iron concentration (0.3 mg L⁻¹) was investigated in female guppy Poecilia reticulata by histopathological approach based on qualitative analysis and histopathological index after acute and long-term exposure. The animals were collected at the beginning of the experiment and after 3, 7, 14 and 21 days of exposure. TEM results demonstrate crystalline and rounded IONP with an average size of 3.97 ± 0.85 nm, and DLS and ELS analysis showed that the IONPs has low hydrodynamic diameter and high surface charge in ultrapure water (14.1 ± 0.2 nm; -51.1 ± 7 mV) compared to reconstituted water (21.4 ± 0.39 nm; -19.5 ± 6.5 mV). The histopathological results showed an increase in the histopathological changes in fish after the 7 days of exposure to IONPs, such micro- and macro-steatosis, melanomacrophage aggregates, exudate and hemorrhagic foci. The acute (3 and 7 days) and long-term (14 and 21 days) exposure of P. reticulata to IONPs induced high histopathological indexes associated with circulatory disorders and inflammatory responses with high foci of melanomacrophages indicating an increase of hepatotoxicity according the exposure time. Furthermore, guppies exposed to IONPs showed increasing in the number of MMC when compared to the unexposed ones. This is a first study about hepatotoxicity of IONPs in guppies. The results indicated that the hepatotoxicity estimated by qualitative parameters and histopathological index are important biomarkers to indicate the animal health and the environmental impact of IONPs. The present study confirming that the guppy P. reticulata is a suitable model to test the hepatotoxicity of IONPs. Keywords: Nanomaterials; biomarkers; nanotoxicology; guppy. Session: Ecotoxicology and human toxicology; from molecules to organisms, from omics to in vivo (Fish model species in human and environmental toxicology) Presentation preference: Poster presentation

(Eco)toxicity tests for hazard evaluation of recycling materials and waste (P)

WE418 Biotests for Hazardous Waste Classification (HP14): benchmarking Limits for Tolerable Ecotoxicity.

R. Weltens, VITO / ABS; e. rossi, OVAM; v. vanermen, VITO; K. Tirez, Flemish Institute for Technological Research VITO

The current HP14 classification is based on the chemical composition of the waste: i.e. the sum of the concentrations of individual chemicals with ecotoxic properties (substances labeled H400, H410, H411, H420) are compared to defined limit values (CLP). In the case of complex waste materials however the analytical data are not used as such but the toxicological test results of the waste in question are compared to the chemical evaluation as step 1 biotests in steps 2 (acute aquatic tests on eluate fractions) and step 3 (acute terrestrial tests on solid waste). Limit values are needed for tolerable ecotoxicity (TE) that are in line with the chemical limit values (step 1). In the study presented here we benchmarked biotest results against waste materials that were proven to be toxic in step 1, and it was concluded that LID4 as TE was a suitable option for our data set. The main conclusions were: The proposed concept of biotests is essential for proper HP14 evaluation. Poor mass balance in the chemical data should be the trigger for the additional use of biotests. LID 4 is proposed as TE
for steps 2 and 3 (to be further evaluated for a larger data set). Both aquatic and terrestrial tests are needed for complete HP14 evaluation. This study was funded by OYAM, the Flemish Waste Agency! The kind help of the technicians Guy Geusens, Cis Boonen, Wilfried Dumortier is highly appreciated.

WE419

What is the future for the waste wood in terms of ecotoxicological testing? S. Legay, FCBA / Chemistry Ecotoxicology Lab; C. Martin, FCBA / Gironde

In Europe, the classification of waste is carried out by an assessment of the hazardousness of the waste using data of known waste composition according to the properties of danger. This classification can be based only on the waste composition if the available data are sufficient and relevant. This method is based on the sum of contributions of different waste classes with the CLP (Classification, Labelling, Packaging) regulation [European regulation [EC] 1272/2008]. In the majority of cases under complex mixtures, or of unknown nature (e.g.: exterior and interior joinery, furniture, panels, wooden paneling, wood flooring, construction waste and demolition,...) including wood preservative, paints, glues, the characterisation of their wastes is considered to be difficult. Ecotoxicological testing seems to be the most relevant because the effects of all contaminants (synergistic effects, additives and antagonists) are integrated. It is a major advantage in the characterisation of waste. In this case, the waste has to be then subjected to a battery of bio tests (aquatic and terrestrial) in order to evaluate one of the 15 existing properties: Ecotoxicity for the environment (HP14). Test strategies will allow wood wastes to be recovered or recycled.

WE420

QUALITY STANDARDS FOR URBAN WASTE FERTILIZERs: PUTTING ECOTOXICOLOGY IN THE PICTURE

S. Chelinho, CFE / Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; C. Venâncio, Department of Biology / Biology; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Sousa, University of Coimbra / Department of Life Sciences

The recently adopted EU Circular Economy Package intends to boost the production and EU movement of fertilizing products, such as those obtained from urban wastes (UWF) and the harmonization of quality standards (certification) for such products, to avoid market rejection. The Portuguese and EU regulation on UWF production/commercialization relies only on physico-chemical and biotechnical analysis, which do not give any insight on the fraction of contaminant/mixture of contaminants bioavailable for organisms, nor the existence of potential antagonistic and/or synergistic effects. The main objective of this study is to develop an environmental quality certification system for the use of UWF in agricultural systems. In the present contribution, it was intended to characterize the ecotoxicological potential of the selected UWF, by evaluating both soil habitat and retention functions using lower-tier laboratory tests. Five UWF, two with origin in source separated organic wastes (group I: theoretically with higher quality, ex. lower metal content) and three originated from the organic fraction of mixed municipal solid waste (group II) were selected and tested using a battery of standardized ecotoxicological assays with plants, soil invertebrates and freshwater species. Five soil-UWF dilutions (0.7; 2.1; 6.3; 18.9; 56.7%) and eluates of pure UWF were used as test-medium. The results show that the highest and lowest toxicity were observed in the two UWF from group I. Among soil organisms the range of sensitivities was: E. andrei > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridissima > R. subcapitata > C. vulgaris > H. incongruens > B. calyciflorus. The observed toxicity was probably related with UWF high salinity rather than with metal contents. The obtained data also reinforce the need to include information from biological susceptibility of the receptors potentially at risk on the available regulation to obtain a more realistic view of the potential risks and to adapt the UWF application practices. Ultimately, a sustainable economic growth based on the efficient use of resources/ waste valorization can be promoted.

WE421

Chemical and Ecotoxicological Assessment of Reclaimed Asphalt for their Subsequent Use

V. Jagodzinski, M. Buczka, R. Lichinsky, J. Hegrova, J. Huzlik, K. Effenberg, Transport Research Centre

Reconstruction and repair of the road infrastructure is a source of the reclaimed asphalt, which is suitable to continue to use. It is also necessary to deal with the environmental impact of these materials within their ongoing life cycle, except testing their mechanical properties. Currently, the environmental impact tests of reclaimed asphalt are performed out in crushed condition, according to the leachability test of granular materials with grain size Scenedesmus subspicatus, Sinapis alba, Daphnia magna were carried out in aqueous extracts. The results were compared with the legislation and were evaluated in terms of the content of the monitored substances and the type of test material.

WE422

Leaching tests - a useful tool for the environmental impact assessment of construction products


Construction products and waste materials used for construction can be in contact with the environment and may release potential harmful compounds. Information on the total content of these substances in the product is not sufficient to assess its environmental impact since it does not consider realistic exposure conditions. Concerning the pathway to soil and groundwater by contact with rain or seepage water leaching tests are available. The aim of this presentation is to show exemplary results of existing leaching methods and underline the strength and weaknesses of this kind of test with selected examples of our work: Concrete roofing tiles with terbutryn were leached according to CEN/TS 16637-2 with permanent immersion into water and according to EN 16105 with nine immersion cycles each consisting of immersion and dry stages. The eluates were divided into subsamples for different parameters as pH, conductivity, total organic carbon, anions, cations and terbutryn. Concerning the assessment of this leaching data it is important to notice that the eluate concentration do not represent necessarily environmental concentrations. Thus, the concentration in the leaching test cannot simply be correlated to limit values of environmental quality standards. Further considerations are necessary including exposure scenarios and environmental pathways before testing leaches can be used in risk assessment.

Advances in monitoring and evaluating remedy effectiveness for in situ amendments in soils and sediments (P)

WE423

Assessment and management of stormwater on sediment recontamination: you don't need to measure everything, just the right things

I. Drygiannaki, Texas Tech University / Department of Civil Environmental and Construction Engineering; D. Reble, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Bejar, Texas Tech University; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; D. Athanasiou, Texas Tech University / Civil, Environmental, and Construction Engineering; D.B. Reble, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; G. Rosen, STP Environmental Services; S. Willitsen, Environmental Protection Agency; M. Oster, Navy Sparaw Systems Center; R. Witt, The University of Alabama; E. Strecker, B. Steets, M. Otto, Geo senate Consultants

Stormwater sources are difficult to understand because of the poor characterization of the irregular, event-driven inputs and the difficulty of managing diffuse sources of large volumes of runoff. The study objective is to develop methodologies to quantify the consequences of ongoing low-level sources on chemical concentrations, contaminant availability, and effects on biological receptors in surficial sediments. The study area was in Palo Alto Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and chemical analysis. Receiving and outfall waters collected using auto-samplers, which were triggered at each location during two different seasons. The samples were analyzed for a variety of metals, PAHs, and PCBs, as a function of particle size. Sediment traps and sediment cores were also collected from the Creek and subjected to bulk chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050A and 3050B, respectively, and were analyzed using ICP-MS and MERX-T. Persistent organic pollutants in water samples were Liquid-Liquid Extracted (LLE) using the modified EPA Method 3510C, while sediment was extracted by Pressurized Fluid Extraction (PFE with ASE 350) using the modified EPA Method 3545A. PAH analysis was performed on HPLC and PCBs on GC/MS. Results showed that storm-events were dominated by coarse particles initially most likely to leach to sediment, followed by a decrease in size-segregated contaminant loads and simultaneous receiving water measurements were very helpful in relating the stormwater discharges to sediment recontamination. The particle associations in stormwater along with spatial distribution particularly in sediment traps, and less in the sediment cores, can identify contributing locations, effective remedial approaches, and help to propose best practices for stormwater and sediment management.

WE424

Development of active capping materials for oil spill contaminated sediment remediation

L. Østergaard, Norwegian Geotechnical Institute; P. di palma, IRSAACNR; C. Riccardi, INAIL; E. Eck, s.e. hale, Norwegian Geotechnical Institute; p. viotti, Università La Sapienza; M.P. Papini, Università La Sapienza / Chemistry

Petroleum is extensively used for making oil-based chemical and energy; its daily
consume is on average 20 million tons and this is not predicted to decrease. The increasing use of the petroleum is inevitably connected to an increase in oil spills. Oil spills can occur for many reasons including human error or equipment failure and whenever an oil spill occurs it can represent a worldwide environmental problem. Effective remediation strategies are required. The aim of this study is to develop different sorbent materials for the active capping of oil spill contaminated sea-sediment. The experimental investigation was performed on an oil spill contaminated sea-sediment. Different sorbent materials were tested for the active capping: a commercial Activated Carbon (AC) Carbonititia, an organophilic clays (OC) CETCO Inc. and a biochar (BC). The sorption properties of the materials were first investigated in aqueous solution by performing equilibrium tests (isotherm) using a mixture of polycyclic aromatic hydrocarbons (PAHs) as target contaminants. The bioavailable concentration was assessed by using polycarbonate (PE) (26 μm) passive samplers. Capping experiments were performed in glass cylinders, where a layer of contaminated sediment (7.5 cm) was capped with a layer of 3 cm of sand mixed with the different tested materials (AC, OC and BC) and synthetic sea water (4 cm) on top. The capping efficiency was assessed by using polydimethylsiloxane (PDMS) fibers as passive samplers. The PAH profiles in the different capping systems were compared in order to assess the capping efficiency. Biochar showed a greater capping efficiency than activated carbon and organoclay. For example, anthracite powertore concentrations in the first centimetre of capping material, were reduced by 69%, 56% and 99% respectively for activated carbon, organoclay and biochar after 1 month. The porewater concentrations were also used to model the long term (<12 months) behaviour of various cap configurations with a numerical simulator. The measured data were used to develop two alternatives to the alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

WE425

Pb2+ Tissue Concentrations and Benthic Community Impacts at a Carbon Amendment Pilot Study in the Intertidal and Subtidal Zones of San Francisco Bay

C.J. McCarthy, CH2M / Environmental Services; C.A. Irvine, RBI / Ecosystem Services; T. Himmer, CH2M; s. clark, Pacific EcoRisk; R. Zajac, J. Eby, CH2M

Historical site activities at the Hunters Point Naval Shipyard (HPNS) in South San Francisco Bay resulted in the release of chemicals, including polychlorinated biphenyls (PCBs), to offshore sediments. To inform remedy selection at this urban site, activated carbon (AC) amendments alternatives were evaluated in a pilot treatability study. Two 0.4 acre plots extending from the intertidal to the subtidal zone were treated with either AquaGate + PAC™ or Sedimite™ were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediment. Previous studies indicated that reducing the bioavailability of PCBs to the bent-nose clams (Macoma nasuta) in shallow intertidal sediments when aided by mechanical mixing. This study assessed the effectiveness of AC placements without mechanical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analysis were measured to determine indicators that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

Comparisons were made between baseline, reference, and post-amendment conditions (8 and 14 months post-placement). PCB tissue concentrations in Macoma sp. were measured in situ (field) and ex situ (bench-top) after 28-day exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and their subsequent exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and their subsequent exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and their subsequent exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and their subsequent exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and their subsequent exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and their subsequent exposures.

WE426

Remediation of mine wastes with biochar: effect on metal bioavailability to earthworms

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diez-Ortiz, Leitat Technological Center

The impact of two biochar-based amendments (one from pruning trees and other from sewage sludge) in metal toxicity and bioavailability was assessed in an acid (A) and an alkaline (B) mine waste before and after incubation under different simulated field conditions (irrigation versus drying flooding periods). Metal CaCl2-extractable fraction, survival and metal tissue concentrations in the earthworm Eisenia fetida exposed to bulk (mine wastes) were measured. Survival of E. fetida was recorded after 21 days of exposure to six serial dilutions of mine wastes mixed with uncontaminated Lufa 2.2 natural soil containing waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and internal tissue metal concentration in surviving earthworms were measured. No signs of toxicity and no significant effects on survival of the organisms were observed in alkaline mine waste B. In contrast, exposure at time 0 to untreated acid mine waste A caused a 71 % of mortality. The addition of biochars decreased toxicity in mine waste A and Cd internal concentrations in surviving organisms, indicating a lower metal bioavailability. Over time, survival in the untreated acid mine waste increased and internal metal concentrations were significantly different among treatments and incubation conditions. A strong decrease in Cd, Zn and Pb CaCl2-extractable fractions was observed in all the mine waste dilution in both biochar treatments comparing to untreated mine waste, with no significant differences among treatments or flooding conditions. Addition of biochar also leads to an increase in the pH, which might explain the reduction in metal bioavailable fraction and the consequent decrease in organisms’ body metal bioaccumulation.

WE427

Remediation of mine wastes with biochar: effect on metal bioavailability to Eisenia fetida

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diez-Ortiz, Leitat Technological Center

The overall effect of two biochar-based amendments (one from pruning trees and other from sewage sludge) and their efficacy for metal immobilization in an acid (A) and an alkaline (B) mine wastes were assessed. Two different simulated field conditions, irrigation periods versus alternating flooding-drying periods, were evaluated before, immediately after and after 10 months of incubation. Besides physicochemical characterization, ecotoxicological assays with Enchytraeus crypticus exposed to both: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailable fraction and risk of exposure. Survival of E. crypticus exposed to mine waste pore water solutions in an inert quartz sand matrix was evaluated after 10 days of exposure. The addition of biochars decreased toxicity in mine waste A and its pore water solution on terest and survival decreased, with no significant differences between different type of biochars were found. Our results showed that biochar treatments decreased the bioavailable fraction of Pb, Zn and Cd in the soil solution, reducing the toxicity of the acid mine waste to earthworms.

WE428

Bioavailability-based Methods to Assess Remediation Effectiveness

J. Gan, University of California, Riverside / Department of Environmental Sciences; J. Wang, University of California Riverside; A.R. Taylor, University of California Riverside / Environmental Sciences; D. Schlenk, University of California-Riverside / Department of Environmental Sciences; J. Wang, University of California Riverside; A.R. Taylor, University of California Riverside / Department of Environmental Sciences

Bioavailability-based Methods to Assess Remediation Effectiveness

Diez-Ortiz, Leitat Technological Center

Compared to the total chemical concentration, bioavailability is a better measurement of risks of hydrophobic organic contaminants (HOCs) to biota in contaminated soil or sediment. Many different bioavailability estimation methods have been introduced in order to assess the effectiveness of remediation treatments. However, to date the different methods have rarely been evaluated against each other, leading to confusions in method selection. In this study, four different bioavailability estimation methods, including solid phase microextraction (SPME) and polyethylene passive sampling (PE) aiming to detect free chemical concentration (Cfree), and Tenax desorption and isotope dilution method (IDM) aiming to measure chemical accessibility, were used in parallel to estimate bioavailability of DDT (DDX) in a historically contaminated Phragmites australis field and on another different black carbon sorbents. Bioaccumulation into earthworm (Eisenia fetida) was measured concurrently for validation. Activated carbon or biochar amendment at 0.2-2% decreased earthworm bioaccumulation of DDXs by 83.9-99.4%, while multi-walled carbon nanotubes had a limited effect (4.3-20.7%). While all methods correctly predicted changes in DDX bioavailability after black carbon amendment, passive samplers offered more accurate predictions. Predicted levels of DDXs in earthworm lipid using the estimated bioavailability and empirical BCf values matched closely with the experimentally derived tissue concentrations. However, Tenax and IDM underestimated bioavailability when the available DDX levels were low. Our findings suggested that both passive samplers and bioaccessibility methods may be used in assessing remediation efficiency, presenting flexibility in method selection. While accessibility-oriented methods offer better sensitivity and shorter sampling time, passive samplers may be more advantageous because of their better performance and compatibility for in situ deployment.
WE429
Identification, Quantification, and Risk Assessment of Polycyclic Aromatic Hydrocarbons and their Polar Derivatives in Soil After Steam Enhanced Extraction
L.S. Time, Oregon State University / Chemistry / Environmental and Molecular Toxicology; E. Busch, Oregon Department of Environmental Protection Agency / Ground Water & Ecosystems Restoration Division; S.L. Massey Simonich, Oregon State University / Department of Environmental and Molecular Toxicology

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants produced from the incomplete combustion and pyrolysis of organic matter, and are among the major contaminants in soils. Steam enhanced extraction (SEE) is an in situ thermal remediation technique that uses the addition of steam to soil subsurface to increase the removal efficiency and recovery of volatile and semi-volatile contaminants, like PAHs. However, there is limited research on formation of PAH derivatives during SEE of PAHs. Polar PAH derivatives are more mobile in the environment than PAHs, and some are more toxic than corresponding PAHs. There is an urgent need for analytical methods that can accurately quantify PAH derivatives in complex matrices, to better understand the chemistry occurring during SEE, and how it interferes with the remediation of soils. In this study creosote-contaminated soil from the Wyckoff/Eagle Harbor Superfund Site in Washington, USA was thermally treated with laboratory-scale SEE. Soil pre- and post-SEE, effluent collected during SEE, and pre- and post-SEE leachate samples (mimicking rain runoff and groundwater) were collected and analyzed with gas chromatography/mass spectrometry (GC/MS). Pol PAHs, polar PAHs, and MW302-PAHs (n=97). Most of analyzed PAHs were quantified in all pre-, post- and effluent samples. PAHs decreased significantly, while polar PAHs increased in mean concentration post-SEE soil. Mass balances were estimated for different PAHs, and some were above 100%, indicating the potential formation of PAH derivatives during SEE. These findings suggest that SEE pilot and treatability studies should include analysis of PAHs and PAH derivatives to risk assessments to assess the full effectiveness of SEE and prevent underestimation of potential risks. A quantitative risk assessment will be performed by calculating B[a]P concentrations and estimated lifetime cancer risk (ELCR) ingestion estimates. Developmental toxicity testing will be conducted with dechorionated zebrafish (Danio rerio) embryos (n=32/treatment) placed into 96-well plates containing pre- and post-SEE soil, effluent, and pre- and post-seeachate extract samples at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post fertilization. This study quantified PAH derivatives after SEE, and it will identify implications for risk assessment and developmental toxicity outcomes.

WE430
Enhanced total petroleum hydrocarbon removal without soil disturbance by serial surfactant foam spraying
R. Bajagain, Y. Park, Kunsan National University / Chemistry; S. Jeong, Kunsan National University / Department of Environmental Engineering

Fuel spills are a complex mixtures of hydrocarbons. Molecular hydrocarbons are readily biodegraded in the natural soil system. Diesel includes recalcitrant hydrocarbons to the natural degradation and may act as potential and actual sources of harmful human and ecological effects. The purpose of the study was to evaluate serial surface foam spraying technology, which avoids disturbing the soil, to deliver chemical oxidant and oil-degrading microbes to unsaturated soil. Hydrogen peroxide was used as a preferred bioaugmentation. All oxidants were applied to the surface soil by surfactant foam spraying. Surfactant foam would be a good media to spread remediation agents to the surface of contaminated sites with less labor or energy. Surfactant foam was sprayed once onto diesel contaminated soil for oxidation of soil total petroleum hydrocarbon (TPH). Periodic bioaugmentation foam was sprayed every three days for biodegradation of soil TPH. Foam spraying employing oxidation-bioaugmentation serial application significantly reduced soil TPH concentrations to 550 mg/kg from an initial 7470 mg/kg. Application of hydrogen peroxide by foam spraying increased the infiltration of hydrogen peroxide into the unsaturated soil. The easy and even infiltration of remediation reagents increased the contact with contaminants, resulting in enhanced oxidation and biodegradation. Fractional analysis of TPH showed C18-C22 present in diesel as biodegradation recalcitrant hydrocarbons. Recalcitrant hydrocarbons were reduced by 92% using oxidation-biodegradation serial foam, while biodegradation alone only reduced the recalcitrant fraction by 25%. (This work was supported by National Research Foundation of Korea (NRF-2015R1D1A1A01059664)).

WE431
Factors affecting sorption of halogenated phenols to polymer/biomass-derived biochar: Effect of pH, hydrophobicity, and depolytronization
S. Oh, University of Ulsan / Department of Civil and Environmental Engineering; Y. Seo, University of Ulsan / Civil and Environmental Engineering; T. Seo, University of Ulsan / Department of Civil and Environmental Engineering

High performance biochar synthesized via co-pyrolysis of polymer and rice straw (RS) was evaluated as a sorbent for ionizable halogenated phenols. Compared with RS-derived biochar, the sorption of 2,4-dichlorophenol (DCP), 2,4-dichlorophenol (DBP), and 2,4-difluorophenol (DFP) to polymer/RS-derived biochar was significantly enhanced by changing properties of biochar due to polymer residues, probably via hydrophobic sorption and electron donor-acceptor interactions. Removal of polymer residues and increasing aromaticity of polymer/RS-derived biochar at elevated pyrolysis temperatures affected the sorption capacity of halogenated phenols. Surface charge of biochar and depolytronization of the halogenated phenol biochars were other factors to be responsible for the sorption to polymer/RS-derived biochar. Competition with other halogenated phenols and dissolved cations implied that similar sorption mechanisms were existed and that surface complexation and electron donor-acceptor interactions were involved in the sorption to polymer/RS-derived biochar. Our results suggest that co-disposal of biomass and thermoplastic wastes through pyrolysis may be an effective option to produce a high-performance upgrade biochar as a sorbent for various types of contaminants.

WE432
Biochar for soil management: interactions with legacy contaminants and current-use pesticides
L. Bajak, R. RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Kročová, Masaryk University / Faculty of Science, RECETOX; L. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX)

Biochar (BC) is a product of thermal decomposition of biomass under oxygen-limited conditions. BC has received extensive attention because of its multifunctionality for gas uptake of contaminants and air pollution. Besides, it is well known that BC possesses excellent sorption properties making BC a valuable sorbent in the treatment of solids contaminated with hydrophobic organic compounds (HOC) and wastewater. Due to its assumed stability, BC is considered an environmentally compatible approach for carbon sequestration and thus, climate change mitigation. In application to agricultural soils has been shown to increase soil fertility, mainly due to improved nutrient and carbon availability, protection of microorganisms, and increased water holding capacity. Despite these benefits, very little BC is currently utilized as soil amendment, mainly because the mechanisms improving soil health are poorly quantified and understood. Besides, there are several concerns and unknowns for BC agricultural application: i) the presence of pollutants (HOC, heavy metals) originating in pyrolysis or feedstock; ii) lower specificity resulting in transport of BC and BC-associated pollutants into surface water bodies; iii) substantial reduction of efficacy of agrochemicals; iv) effect of BC stability during weathering on its application potential, particularly long-term fate of agrochemicals. In this study, the role of BC in the management of contaminated soils and in the management of pesticide-treated agricultural soils is addressed. A systematic approach is devoted to the positive effects of reducing bioavailability of toxic contaminants and the ambiguous effects of reducing bioavailability of intentionally applied current-use pesticides. For that purpose, two different biochars were applied at increasing doses to soils amended with DDE and with epoxiconazole and tebuconazole as representative of legacy contaminants and broadly used fungicides, respectively. Bioavailability was assessed by means of solid-phase microextraction as well as by methods of gas uptake of contaminants and air pollution. BC derived as a model ecotoxicologically relevant organism. The influence of biochar properties and biochar dose was considered. At the same time, the well-being of earthworms in biochar-amended control soils was detected. This study aimed at balancing the dosing of biochar in soil management to ensure both an efficient and sustainable control of diffuse contamination and of pests.

WE433
PREPARATION AND CHARACTERIZATION OF COMPOSITES OF TYPE CLAY / POLYMERS AND THEIR USE IN THE REMOVAL OF CONTAMINANTS ORGANICS OF AQUATIC ENVIRONMENTS.
M.S. Rodrigues, Instituto Federal do Maranhão; L. Aguilar Vieira, Universidade Federal do Maranhão; A. Costa Filho, S.G. RIBEIRO, Universidade Federal do Maranhão

Clays have been used by mankind to many years due to its easy to obtain, its high technical viability rate and low economic cost. Among countless uses for the clay, research related to its various properties and also the adsorption capacity of this material has gained prominent scientific attention. Availability of diffusion and / or activation of these properties can be improved, resulting in a direct increase in the adsorption rate. The changes made in the samples of clays of this work were made from 2,6-bromoniono polymer, the process of cation exchange, which generated organopholic characteristics for samples, allowing comoadsorventes of contaminants and the ambiguous effects of reducing bioavailability of intentionally applied current-use pesticides. For that purpose, two different biochars were applied at increasing doses to soils amended with DDE and with epoxiconazole and tebuconazole as representative of legacy contaminants and broadly used fungicides, respectively. Bioavailability was assessed by means of solid-phase microextraction as well as by methods of gas uptake of contaminants and air pollution. BC derived as a model ecotoxicologically relevant organism. The influence of biochar properties and biochar dose was considered. At the same time, the well-being of earthworms in biochar-amended control soils was detected. This study aimed at balancing the dosing of biochar in soil management to ensure both an efficient and sustainable control of diffuse contamination and of pests.
Acidification of the earth’s surface is a complex event, involving both natural and anthropogenic processes. The extent of acidification can be evaluated using various indicators, such as pH measurements in precipitation and soil samples, and the concentrations of acidic species in atmospheric and terrestrial environments. The analysis of these indicators can provide insights into the sources and mechanisms of acidification, which can be used to develop strategies for mitigation and remediation. The long-term effects of acidification on ecosystems and human health are also important areas of research, as they can lead to changes in the distribution and abundance of species, as well as alterations in the function and structure of ecosystems. These changes can have cascading effects on the global carbon cycle and the availability of critical ecosystem services. Therefore, understanding the causes and impacts of acidification is crucial for the development of effective strategies to address this global environmental problem.
Due to the constant increase of plastic use and production, microplastics (MPs) have become a contaminant of serious concern for the marine environment. However, detailed information about biological pathways affected by the exposure to different MP polymers is still lacking, in particular at transcriptome level. The present study focused on the identification of the molecular pathways affected by a chronic exposure of zebrafish (Danio rerio) to different concentrations of a coastal and a deep-sea MP for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and poly styrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next-generation sequencing technologies in Illumina HiSeq. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microplastics affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

**TH005**
Uptake and Effects of Synthetic and Natural Microparticles in the Shrimp Palaeomon varians

M. Weidung, University Duisburg-Essen; R. Saborowski, L. Gutow, Alfred Wegener Institute for Polar and Marine Research

Microplastics (< 5 mm) have become ubiquitous in waters. The smaller they are the easier they can be taken up by aquatic organisms. Once ingested they can cause various harmfull effects. This study investigates the effects of artificial and natural particles on the induction of cellular stress in the Atlantic shrimp (Palaeomon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive organs was observed by fluorescence microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the surrounding tissue and into the midgut gland. Decapods have a lumen of the gut. The smaller particles (0.1 µm) were translocated into the digestive gland. Superoxide dismutase activity was rapidly induced 2 hours after ingestion and remained high after 48 hours. Slight difference appeared between natural and synthetic particles. The diatom powder also induced SOD activity which, however, continuously decreased with time. Due to the enzyme cascade where SOD reacts first, the activity of catalase was clearly lower. It can be assumed that any particles < 170 nm enter the cells of the midgut gland and induce oxidative stress. Following optical detection of reactive oxygen species (ROS) via confocal laser scanning microscopy will help to identify cellular reactions after exposure to microparticles.

**TH006**
Microplastics in the sub-surface layers of the South Atlantic Ocean

V. van der Schyff, North-West University / Unit for Environmental Sciences and Management; J. Karstensen, GEOMAR - Helmholtz Centre for Ocean Research Kiel; R. Morard, Bremen University / MARUM - Centre for Marine Environmental Sciences; S. Speich, Ecole Normale Superieure de Paris; H. Bouwman, North-West University / Unit for Environmental Science and Management

Microplastic particles in the ocean is a major environmental concern. Most studies tend to concentrate on the ocean surface when examining microplastic pollution. However, it is known that, for various reasons, microplastics can lose buoyancy and sink to the sea floor. An indication of the occurrence of the Southern Atlantic Ocean (SAO) was determined. The study was conducted from the RV METEOR, a German research vessel. The cruise was from Cape Town, South Africa, to Rio de Janeiro, Brazil, from the 29th February 2016 to 18th March 2016. A multinet with a mesh size of 25 µm was deployed at fourteen stations across the SAO, and sampled at increments of 20 m (0-20 m, 20-40 m, 40-60 m, 60-80 m, and 80-100 m). The contents of the multinet samples were filtered through a 1 mm sieve. The remainder of the samples was pressure filtered through black filter paper (to ensure optimal visibility of the microplastic particles), and air-dried. The dried samples were examined under a dissection microscope, and the microplastic particles counted visually. The highest density of microplastic particles were found in the top layer (0-20m), at 52%. Seventeen percent of the particles were found at 20-40m, 14% in 40-60m, 9% in 60-80m, and 8% in 80-100m. There was a high microplastic count near the South African coast (10^5-6). After crossing the Walvis Ridge and sailing into the high pressure system over the SAO, the plastic count decreased dramatically. A fairly homogenous stratification was observed in the high pressure system. Near Brazil, the microplastic concentrations increased again. In the eye of a cyclonic eddy, microplastics were slightly less stratified. This study was intended as a pioneer study to determine whether microplastics are stratified in the water column. This was found to be the case.

**TH007**
Effects of dietary microplastic exposure on fish intestinal physiology

G. Asmonaite, H. Sandhu, N. Asker, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences

The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route for plastic debris for a variety of species, including fish. Large plastic items are known to physically block the intestinal passage, exert physical damage, impair food uptake and/or cause false satiation. Whereas, the biological effects resulting from ingestion of smaller micro-sized particles or microplastics (MPs) are considerably less documented and potential (negative) consequences on the alimentary tract are largely unknown. To address this, we designed a study aimed at assessing if/how ingestion of MPs can affect physiological function of the intestine in fish. We hypothesized that ingestion of MPs cause inflammatory responses and disturb intestinal barrier and transport functions. Juvenile rainbow trout (Oncorhynchus mykiss) were exposed via diet to polystyrene (PS) particles (50-250 µm, 10mg of PS MPs/fish/day) for a period of 4 weeks. Fish were fed four types of diets: control (no PS MPs) and diets containing untreated PS particles (PS-purified) or particle-exposed and environment (PS-exposed) and PS-fish diet and food supplemented with one of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next-generation sequencing technologies on an Illumina HiSeq stem. Near Brazil, the microplastic concentrations increased again. In the eye of a cyclonic eddy, microplastics were slightly less stratified. This study was intended as a pioneer study to determine whether microplastics are stratified in the water column. This was found to be the case.

**TH008**
Biochemical responses and histological effects resulting from foodborne exposure to post-consumer microplastics in juvenile Solea senegalensis

M. Martins, Faculty of Sciences and Technology, Universidade Nova de Lisboa / DCEA; B. Carney Almroth, University of Gothenburg / Unit for Environmental Sciences and Engineering; M. Gonçalves, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; P. Sobral, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; B. Carney Almroth, University of Gothenburg / Unit for Environmental Sciences and Engineering

Microplastics (MPs) have dramatically increased in marine environments, being recognized as ubiquitous environmental pollutants. Two types of microplastics are usually detected in environmental samples: the primary MPs originally and intentionally manufactured MPs and the secondary MPs which result from the fragmentation of dumped plastic items. The latter are normally referred as post-consumer microplastics and usually present different shapes, colors, composition and irregular surface. However, few toxicological studies have addressed exposure of marine organisms to post-consumer microplastics. The goal of the present research is to assess the effects of post-consumer microplastics in zebrafish (Solea senegalensis), using diet as the microplastic vehicle. For this purpose, four distinct diets were prepared using commercial fish pellets incorporated with two MPs sizes (< 200 µm and 300-500 µm) and two concentrations of each (562 and 56 MPs per day) and other without MPs (control), making a total of five treatments. Sixty-day laboratory assays were conducted, in duplicate, and the test pellets were provided to fish once a day. After 14, 30 and 60 days, fish were sacrificed from each treatment and excised. The liver and stomach from fish were excised and stored at -80°C for biochemical analysis. The digestive tract was also sampled and immersed in Davidson’s fixative for histopathological analysis. Biomarkers related with oxidative stress were analysed, namely the lipid peroxides, glutathione and the activity of catalase, superoxide dismutase and acetylcholinesterase. Histopathological analyses were also performed in the digestive tract to assess the presence of MPs and possible histopathological effects.

**TH009**
Nanoplastic impacts on physical, biochemical, and nutritional characteristics

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of Pacific whiteleg shrimp

Y. Chae, Konkuk University; D. Kim, Konkuk University / Department of Environmental Health Science; Y. An, Konkuk University / Department of Environmental Health Science

Because of enormous amounts of plastic wastes in marine environment, the concerns about marine pollution and ecological damages on marine organisms have increased. Especially, among these plastic wastes, small sized plastic particles like microplastics (< 5 mm) and nanoplastics (< 100 nm) are getting a lot of attention and the researches about their impacts and effects in environments are under way. In this study, we assess various physical, biochemical and nutritional changes in the bodies of Pacific whiteleg shrimp (Litopenaeus vannamei) exposed to nanoplastics. For 21 days, shrimps were fed muscle (Mytilus edulis) contaminated with nanoplastics (44 nm diameter) and their physical (length, weight, water content, body mass index), biochemical (catalase, CAT; glutathione S-transferase, GST; superoxide dismutase, SOD; fecal microbiota viability), and nutritional (crude lipid, crude protein, amino acids, and fatty acids) changes were assessed after exposure. In results, nanoplastics attached on the filter and ingested to shrimp's bodies of shrimps and affected the health and physicochemical properties of shrimps. Especially, biochemical changes of nano-sized plastics were significantly induced in the bodies of shrimps. These results can be the evidence of the impacts of small sized plastics on marine organisms. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and Future planning (2016R1A2B5014445).

TH010

Brood Pouch-mediad Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis

M.G. Vijver, CML Leiden University / Conservation Biology; N.R. Brun, CML Leiden University / Institute for Environmental Sciences

Polypropylene debris is ubiquitously distributed in aquatic environments and are considered as an emerging environmental issue for marine organisms across trophic levels. While ingestion of particles receives most attention, other routes of uptake have been considered an emerging environmental issue. In this study, we investigated bioaccumulation of nanoparticles and likely other lipophilic contaminants. Since nanoplastic debris is ubiquitously distributed in aquatic environments and are considered an emerging environmental issue for marine organisms across trophic levels. While ingestion of particles receives most attention, other routes of uptake have been considered an emerging environmental issue. In this study, we investigated bioaccumulation of nanoparticles and likely other lipophilic contaminants. Since nanoplastic debris is ubiquitously distributed in aquatic environments and are considered an emerging environmental issue.

TH011

Micro- and nanoplastic ingestion in blue mussel larvae

S. Rind, DTU (Technical University of Denmark) / Department of Environmental Engineering; A. Baun, Technical University of Denmark / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment

A large number of aquatic species have been found to ingest microplastics in the field and in laboratory studies. Benthic invertebrates seem to be especially exposed to this form of pollution and the blue mussel Mytilus edulis is one of the species that has been investigated most in this respect. Studies have not only shown that the mussels ingest microplastics but have also reported diverse adverse effects on a cellular to a physiological level. However, the work has so far only focused on adult mussels and it is unclear how blue mussel larvae interact with and are affected by plastic particles. In this study, we monitored in situ and nanometre size range. Therefore, these results, illustrating the likelihood of brood pouch-mediated PSNP uptake by embryos, whether the observed brood pouch-mediated PSNP uptake ultimately translates to long-term effects under chronic exposure to environmentally relevant concentrations remains a challenging area for further research. By demonstrating embryo PSNP uptake via the brood pouch, data presented here give novel insights into bioaccumulation of nanoparticles and likely other lipophilic contaminants. Since this uptake route can occur within a diverse array of aquatic organisms, this study warrants consideration of brood pouch-mediated accumulation in efforts studying the hazards and risks of nanoparticle contamination.

TH012

The sub-lethal impact of polystyrene microplastics and nanoplastics on the Mediterranean mussel M. galloprovincialis

M. Capolupo, erasmus mudus PhD in Marine and coastal management (MACOMA) - University of Cadiz / Inter-Departmental Research Centre for Environmental Science (CIRSA); P. Vbbonesi, University of Bologna / Department of Biological, Geological and Environmental Science (BiGea); S. Fribelli, University of Bologna / Department of Biological, Geological and Environmental Science (BiGea); E. Fabbi, University of Bologna / Biega Department via Selmi Bologna

The contamination of marine environments by microscopic plastic debris is a current threat to the fitness of the exposed biota, and even higher concerns are risen on its potential fragmentation to the nanoscale. In the framework of the JPI Oceans project PLASTOX, we investigated the chronic effects induced by a 21-day exposure to 1.5, 15 and 150 ng/L of polystyrene microplastics (MP, 3µm) and nanoplastics (NP, 50 nm) on the fitness of the marine mussel Mytilus galloprovincialis. To do so, we employed a multiforner approach encompassing immunological responses (lysozyme and phagocytosis), lysoosomal endpoints (lysosomal membrane stability and neutral lipids), oxidative stress (catalase activity, malondialdehyde and lipofuscin content) and detoxification (glutathione S-transferase) parameters and neurotoxic effects (acetylcholinesterase activity). The lysosomal membrane stability, whose impairment is a known general stress symptom, was generally reduced in mussel hemocytes after exposure to both MP and NP; however, only in MP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by both MP or NP treatment, with a general decrease in the immune system efficiency. All the performed treatments led to an accumulation of neutral lipids in the mussel digestive gland. Moreover, an accumulation of malondialdehyde and lipofuscin was observed at 150 ng/L NP and at 1.5 and 150 ng/L MP. In gill, catalase was up-regulated following either MP (1.5 and 15 ng/L) or NP (1.5 ng/L) treatments, while a decreased acetylcholinesterase activity was noted only at 15 ng/L NP. Biomarker data were integrated in the Mussel Expert System (MES), which estimates the stress level induced on mussels by calculating a A.E-scale health status index (HSL). The MES did not identify health alterations in control and at 1.5 ng/L MP (HSL = A), while the onset of a low stress level (HSL = B) was detected at 15 and 150 ng/L MP. Differently, the stress level associated to NP treatments was moderate (HSL = C) at 1.5 and 15 ng/L, and low at 150 ng/L. Overall, results show that both polystyrene MP and NP induce a chronic stress syndrome in mussels by affecting lysosomal integrity and generating pro-oxidant conditions. However, the two particle types can differentially alter immunological and neurological processes, with the exposure to NP resulting in a higher impact on the overall mussel fitness compared to MP.

TH013

Effect of cationic amino (PS-NH2) polystyrene nanoparticles in brine shrimp Artemia franciscana nauplii: biochemical and molecular responses

I. Varo, CSIC Spanish National Research Council / Biology, culture and pathology of marine species; A. Petini, CSIC Spanish National Research Council; E. Liberatori, University of Cadiz / Inter-Departmental Research Centre for Environmental Science (CIRSA); G. Pandolfino, University of Siena / Department of Physical, Earth and Environmental Sciences; L. Corni, University of Siena / Physical, Earth and Environmental Sciences

The accumulation of plastic litter on beaches and open oceans has been identified as one of the major threats in marine ecosystems worldwide. Laboratory experiments have proved that the formation of nano-sized plastics during the polymer degradation may reach marine ecosystem, considered as the most in danger. In present study, the effect of 50 nm cationic amino polystyrene (PS-NH2) was investigated in nauplii of Artemia franciscana, which is commonly used as aquatic model organism in toxicity tests. Acute toxicity tests were performed on nauplii exposed to sub-lethal suspensions of PS-NH2 (0,1, 1 and 10 µg/mL) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carboxylesterase (Ceb), glutathione S-transferase (GST), cholinesterase (Che), heat shock protein (HSP70), lipid peroxidation (LP) and catalase (CAT), involved in important physiological processes, such as biotransformation of xenobiotics, neuronal transmission and oxidative stress. The effects of PS-NH2 (at 0.1 and 1 µg/mL) on the expression of genes related to metabolism, biosynthesis and embryogenesis during the development of brine shrimp was also investigated. Genes included HSP26, HSP70, mitochondrial uncoupling protein 2 (UCP2), chaperon-containing TCP (TCP) and late embryogenesis abundant (LEA). Acute exposure to sub-lethal suspensions PS-NH2 caused a significant decrease in growth in A. franciscana nauplii, as well as significant changes in all biomarkers studied, except for LP. A significant up-regulation of HSP26 and HSP70 was observed in nauplii exposed to 1 µg/mL of PS-NH2 as well as the modulation of TCP, the latter not significant. This supports the results obtained from biomarkers, suggesting a stress response and potential

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apoptotic pathway following PS-NH₂ exposure. On the contrary, no significant effect on gene expression related to the brine shrimp’s metabolism (UCP2) was observed, and LEA was significantly modulated only at the lowest concentration tested. These findings indicate that stress-related responses are taking place in exposed nauplii after acute exposure to sub-lethal suspensions of PS-NH₂, and confirm the general concern about PS-NH₂ and their ability to represent an ecological treat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering longer-term exposure to analyze the potential risk of nano-sized plastics in marine environments.

TH014 The impact of nanoparticles on Antarctic krill Euphausia superba E. Bergami, G. Liberatori, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Manno, C.M. Waluda, British Antarctic Survey; S. Cappello, CNR IAMC; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

Under current climate change scenarios, Antarctic krill (Euphausia superba) is facing multiple stressors, which could affect its abundance and distribution. Microplastics have been recently reported in Antarctic waters, representing an additional potential impact on krill population. In this study we investigated the effects of model nanoparticles (< 1 µm) on krill juveniles through short-term exposure (48 h) of polystyrene nanoparticles (PS NPs) with different surface charge. The behaviour of anionic (60 nm PS-COOH) and cationic (50 nm PS-NH₂) NPs in Antarctic natural seawater (NSW, 34‰, 2°C) was also investigated by Dynamic Light Scattering. PS-COOH formed nanoscale aggregates (average size of 862 nm) in Antarctic NSW, while PS-NH₂ maintained their nominal size. No mortality was observed upon exposure to 2.5 µg/ml PS NPs after 48 h. However, krill exposed to PS-NH₂ showed lower motility than individuals exposed to PS-COOH and were characterised by significant up-regulation of αβ6 gene involved in new cuticle formation. Similar findings reported for the Antarctic microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in faecal pellets (FPs), which were characterised by lower density and sinking rate compared to control. Our findings demonstrate that PS NPs are able to affect swimming behaviour, cuticle formation and FPs properties of Antarctic krill, with potential serious consequences on Southern Ocean food web and biogeochemical cycle.

TH015 Exposure to nanoparticles as a potential stressor on Mytilus galloprovincialis I. Brandts, M. Teles, Universidad Autonoma de Barcelona; A.P. Gonçalves, S. Barreto, University of Aveiro / Biology Department & CESAM; L. Sørensen, SINTEF Ocean / Environmental Technology; D. Altin, BioTrix; A. Booth, SINTEF of Material Flow Management and Resource Economy Germany; R. Sempere, V. K. Sakaguchi, Leibniz Institute of Freshwater Ecology and Inland Fisheries; C. Zarlé, University of Aveiro / Center for Marine Environmental Research; Cappello, CNR IAMC; A.M. Soares, University of Aveiro / department of Biology & CESAM; L. Tort, Universitat Autonoma Barcelona / Department of Cell Biology Physiology and Immunology; M. Oliveira, University of Aveiro

Physico-chemical and marine environment is a worldwide problem, especially since plastic materials degrade into nano-size particles, becoming more bioavailable and constituting a source of entry of other contaminants into marine organisms. The present study aimed to assess the effects of polystyrene nanoparticles (PSNP) and clarify their modulation of short-term carbamazepine (cxb) toxicity on bivalve Mytilus galloprovincialis. Mussels were exposed for 96 h to test concentrations of cxb alone, to PSNP alone and to cxb and PSNP. Molecular and biochemical biomarkers were evaluated in digestive gland, gills and hemolymph. Abundance of mRNA in digestive gland and gills revealed significant alterations in expression of genes associated with biotransformation, DNA repair, cell stress-response and innate immunity. Combined exposure induced significant down regulation in gene expression when compared to individual exposure. Total antioxidant status values suggest oxidative stress after exposure to 0.5 mg/L PSNP, whereas increased total antioxidant capacity and esterase activity suggest activation of antioxidant defenses after exposure to 50 µg/L PSNP. Exposure to 0.05 and 0.5 mg/L PSNP induced effects on neurotransmission in hemolymph. In gills, almost all experimental exposures induced inhibition of AChE and ALT values. Genotoxicity was found in hemocytes after exposure to PSNP, cxb and their mixture.

TH016 The role of microplastic size and type on PAH sorption and bioavailability to copepods L. Stromgren, SINTEF Ocean / Environmental Technology; E. Rogers, Norwegian University of Science and Technology; M.U. Ronsberg, SINTEF Ocean / Environmental Technology; D. Atlin, BioTrix; A. Booth, SINTEF Ocean / Environmental Technology

It has been proposed that microplastic (MP) may act as a vector for a wide range of chemical pollutants already present in the environment. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous pollutants in the environment, known to cause adverse effects to a variety of marine organisms. Most PAHs have relatively high polymer-water partition coefficients, meaning their potential for sorption to, and transport by, MPs is high. In both field and laboratory studies, a broad range of marine species have been shown to ingest significant quantities of MP, with extended periods of retention observed in some cases. If PAHs are adsorbed to the MP, this could present an alternative exposure route to PAHs for such species. However, the effect of MP sorption on PAH bioavailability in the marine environment remains poorly understood. Although several studies have attempted to study bioavailability of MP-adsorbed PAHs to aquatic organisms, most studies employ approaches that do not allow the accurate determination of PAHs released from adsorbed compounds or from compounds that have dissolved from the MPs into the exposure media. Here, we investigate the sorption kinetics and present adsorption isotherms for three model PAHs (fluoranthene, phenanthrene and 1,3-dimethylnaphthalene) to a range of different MP’s in natural seawater. The selected PAHs exhibit different sizes and hydrophobicities, thus having varying sorption solubility (two to three orders of magnitude). In the case of the fluorescent dye compound, fluoranthene, MP sorption could prove an important route of uptake in pelagic organisms. To account for the natural variability of MP’s present in the marine environment, test materials with different sizes, shape (particles, fibres) and polymer compositions (polyethylene and polystyrene microbeads, polyester microfibres) were used. Using a novel approach, the influence of MP sorption on PAH bioavailability to two marine copepod species (Acartia tonsa and Calanus finmarchicus) was investigated using polystyrene particles with size ranges above and below the ingestion limit for the two species. The range of MP diameters used in the experiments was 10–300 µm. Chemical body burden was measured after exposure to determine bioavailability.

TH017 Limited influence of microplastics on the effects of an endocrine disruptor on the African clawed frog (Xenopus laevis) S. Relhe, Leibniz-Institute of Freshwater Ecology and Inland Fisheries / Ecophysiology and Aquaculture; A. Zikova, W. Kleiner, W. Kloas, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; C. Zarifi, University of Aveiro / Department of Cell Biology Physiology and Immunology; M. Oliveira, University of Aveiro

Microplastics have been recently reported in Antarctic waters, representing an additional potential impact on krill population. In this study we investigated the effects of model nanoparticles (< 1 µm) on krill juveniles through short-term exposure (48 h) of polystyrene nanoparticles (PS NPs) with different surface charge. The behaviour of anionic (60 nm PS-COOH) and cationic (50 nm PS-NH₂) NPs in Antarctic natural seawater (NSW, 34‰, 2°C) was also investigated by Dynamic Light Scattering. PS-COOH formed nanoscale aggregates (average size of 862 nm) in Antarctic NSW, while PS-NH₂ maintained their nominal size. No mortality was observed upon exposure to 2.5 µg/ml PS NPs after 48 h. However, krill exposed to PS-NH₂ showed lower motility than individuals exposed to PS-COOH and were characterised by significant up-regulation of αβ6 gene involved in new cuticle formation. Similar findings reported for the Antarctic microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in faecal pellets (FPs), which were characterised by lower density and sinking rate compared to control. Our findings demonstrate that PS NPs are able to affect swimming behaviour, cuticle formation and FPs properties of Antarctic krill, with potential serious consequences on Southern Ocean food web and biogeochemical cycle.

TH018 Kinetics of POPs sorption and plastic additives release to a variety of polymers under aquatic conditions D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; K. Sakaguchi-Soeder, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; R. Sempere, V. Fauvelle, Mediterranean Institute of Oceanography, Marseille; A. Booth, SINTEF Ocean / Environmental Technology

The PLASTOX project investigates the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems. PLASTOX combines field-based observations, laboratory tests and manipulative field experiments to study the ecological effects of MPs. The use of common microplastic reference materials, including a marine litter-derived MP produced from an environmentally weathered fish box, allows a meaningful comparison of data generated by different partners and across the different activities of PLASTOX. As part of a long-term field experiment conducted at marine locations across Europe (Mediterranean to
Arctic), a range of different virgin polymer pellets (LDPE, PP, PS, and PET), as well as marine litter-derived microplastic particles from the fish box, were deployed underwater in the small boat harbor at Tromsø, Northern Norway for up to 12 months. The deployment device consisted of an empty stainless steel SMPD canister, with the various plastic types placed in reusable, empty teabags made of PP, placed separately in nylon netting. Sampling was conducted 1 week, 1 month, 3 months, 6 months, and 9 months after deployment. Hydrodynamic persistent organic particles such as PAHs, PCBs, DDTs, PBDEs and microparticles were used to establish the adsorption kinetics in seawater under Arctic conditions. Samples were extracted using ultrason and nonpolar solvents, followed by GC and SPE clean up. Chemical analyses using GC/MS/MS and GC/qMS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common pollutants such as phthalates, organophosphate esters, bisphenol A and fluorinated chemicals were estimated from other four post-industrial virgin pellets (LDPE, PS, PVC, PET) according to the same sampling protocol. Chemical analysis was performed using either GC/MS or LC-QTOF.

TH019
Characterization of microplastics present in personal care products and the study of its toxicity mixed with chlorpyrifos on juveniles of Solea senegalensis. G. Albedini, Universidad de Cádiz (Spain) / Toxicology Area; I. Cabrera-Pozo, University of Cadiz / Toxicology Area; D. Coello, R. Rodríguez-Barroso, J. Quiroga, University of Cadiz / Environmental Technology; J. Arrellano, University of Cádiz / Toxicology Area.

In the last few years, different components from personal care products have arrived at aquatic ecosystems because these products are not biodegraded or removed in wastewater treatment plants. Some of the personal care products contain plastic microbead such as exfoliating shower gel, toothpaste and make-up. Creams commonly used and available in supermarkets of our area were used by these assays. The microspheres available in these samples were separated and chlorpyrifos. The particles were identified by Fourier transform-infrared (FT-IR) spectroscopy using a PerkinElmer Spectrum 100. The spectra are recorded in reflection mode in the spectral range 4000-650 cm⁻¹ by co-adding 128 scans at a resolution of 4 cm⁻¹., the particles were identified by comparing FT-IR absorbance spectra of the microplastics to those in a polymer reference library. The microplastics were used in toxicity test. In aquatic ecosystems and their organisms are exposed to complex mixtures of environmental contaminants as pesticides and microplastics. Thus, the effects of microplastics interaction with chlorpyrifos, an organophosphate pesticide, have been studied in this work. The toxicity studies were carried out during 96 hours with continuous ventilation and water renewal every 24 hours, at a temperature of 19-20°C and under 12 h light/12h dark exposure. The juveniles of Solea senegalensis (weight 3.07 ±0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5-80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l), microplastics alone (0.150 mg/l), plus an untreated control and a solvent control (acetone). In these assays not mortality was observed on juveniles with both compounds and their mixtures. Chlorinesterases (CHE) have been used as specific biomarkers of pesticide exposure. In general, there are two type of CHE presented in fish, acetylcholinesterase (AChE) and butyrylcholinesterase (BChE). The AChE was analyzed on the head homogenate of juveniles, after this crude was inhibited with iso-OMPA, which is a specific inhibitor of BChE. The results showed that there was inhibition activity in the head of Solea senegalensis in presence of chlorpyrifos. However, it was not observed significant differences between the same concentrations of chlorpyrifos and its mixture with microplastics.

TH020
Are microplastics inhibitory to Daphnia magna and are they significant vectors for hydrophobic organic pollutants? C. K. Frydkjær, Aalborg University / Biology and Environmental Science; N. Iversen, Aalborg University / Department of Chemistry and Bioscience; P. Roslev, Aalborg University / Biology and Environmental Science.

The presence of microplastics in aquatic ecosystems is of increasing global concern. Ingestion of microplastics may result in adverse effects in aquatic organisms, and thereby increase the exposure and transfer of chemicals. The chemical control was for some treatments lower than the chemical level used in the study. The exposure concentration of chlorpyrifos (500 µg/l) was used for assessing biological effects. There is a growing body of (eco)toxicological studies not mortality was observed on juveniles particle groups indicating a particle transfer of chemicals. The chemical control was for some treatments lower than the chemical level used in the study. The results showed that there was inhibition activity in the head of Solea senegalensis in presence of chlorpyrifos. However, it was not observed significant differences between the same concentrations of chlorpyrifos and its mixture with microplastics.

TH021
Microplastics as vector for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds M. Trefiliev, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; C. Karney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences. Plastic pollution is a recognized global issue and the ubiquity of microplastics (MPs) in aquatic environment is a cause for concern. Potential effects on organisms are still not fully understood, and mechanistic understanding, required to fully reveal consequences of exposure, especially in connection to chemical mixtures, is still lacking. Studies have shown that MPs have capacity to sorb and concentrate hydrophobic organic chemicals (HOCs) in the aquatic environment. There is an ongoing debate about MPs as vectors for chemical contaminants and their relative importance compared to other naturally occurring particulates. The goal of present study was to quantify particle-mediated chemical transfer and using biomarker approach examine associated biological effects in three spined stickleback (Gasterosteus aculeatus). A rapid ingestion feeding study with chemically spiked particles (250µm) was conducted. Two types of synthetic polymeric particles (PE and PS) and non-plastic polymer particles (silica), which were selected as reference material, were used. Selected particles were loaded with three model compounds (benzo[a]pyrene, ethynylestradiol and chlorpyrifos) having distinct toxicological modes of action and different hydrophobicity (log Kow) values. Eight different experimental diets: control diets (negative control), diets with clean particles (PE, PS, silica), diets containing, particles spiked with a chemical mixture (PE-mix, PS-mix, silica-mix) and, finally, diets loaded with only chemical mixture (chemical control) were developed. During the experiment, fish were fed daily (6 % of body weight and 5 % particles) for a period of two weeks. Gene expression of well-established biomarkers (CYP1a, ERα, CB, MT, VTG) and the antioxidant enzyme (GSH-Px) were measured. The results showed that there was no significant difference in gene expression between exposed groups and controls. The findings of this study revealed an indication of NRF2 mediated oxidative stress regulation.
Fish from PS-sewage and PS-harbor treatments had altered expression levels of multiple antioxidant enzymes in liver. Dietary exposure to PS MPs resulted in low-level activation of hepatic oxidative stress, which may not necessarily exert harmful effects on hepatic physiology, but may rather indicate adaptive homeostatic regulation. Differential responses to different PS MPs treatments (PS-sewage and PS-harbor) potentially could be explained by different chemicals associated with particles during in situ exposures.

**TH023 Effects of Nanopolystyrene and the Co-Contaminant Tributyltin on the Nematode Community Structure in Sandy Sediments**

A. Catariño, A. Hommer, Heriot Watt University / ILES; L. Duran Saja, Heriot Watt University; M. Pizarro, Université Bordeaux / EPOC; University of Plymouth / Centre for Environment, Fisheries and Aquaculture Science; A. Calonge, Universitat Pompeu Fabra & IMACS, Barcelona / EPMF; A. Sols-Pinton, Université de Toulon

Contaminant Tributyltin on the Nematode Community Structure in Sandy Sediments

In order to further investigate the effect of nanopolystyrene (nPS) and nPS with the sorbed co-contaminant Tributin (TBT) on free living nematodes on sandy sediments within a mesocosm experiment. Sediment was collected (up to 5 cm depth) at the Eden Estuary, St Andrews, Scotland, UK. The mesocosms (12°C) consisted of glass beakers (1 L) and the exposure took place for up to 2 months. Core samples of sediments were taken each week from the following treatments: 1) Control sediment, 2) Sediment with spiked TBT (0-100 ng/kg), 3) Sediment with nPS (0-12 mg/kg) and 4) Sediment with nPS spiked with TBT (0-10 mg/kg nPS). Oxygen penetration depth (OPD) was determined by measurement of the oxygen saturation in the sediments using a microprofile equipped with oxygen microsensors. Changes in the nematode community structure were measured by assessment of changes nematode diversity (nematodes identified to genus) and dose responses analysed according to nPS and TBT concentration of the sediments. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

**TH024 Nanopolystyrene Induces a Decrease in the Oxygen Uptake of Zebrafish Larvae Enabling Sorbed Benzo(a)Pyrene Bioavailability**

A. Catariño, Heriot-Watt University / ILES; M. Clement, Polyttech Nice Sophia; M. Tait, Heriot Watt University; D. Boyle, Plymouth University; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society

Nanopolystyrene (nPS, 500nm) may result from larger plastic debris released in the environment and can pose a risk to marine organisms and ecosystems. The risk of NPs can be exacerbated because toxicants sorbed to NPs may be transported to and become more bioavailable in organisms. It is likely that NPs are the most abundant plastic particles present in marine environments, and as in the case of microplastics, they are expected to accumulate in benthic ecosystems. However, there is no indication on the impact of NPs on benthic meiofauna assemblages. It is critical to understand impacts of NPs on sediments of NPs because meiofauna communities play key roles on ecosystem functions such as food production and nutrient cycling. Nematodes are well established as pollution indicators and structural shifts in their communities reflect environmental changes. The goal of our work was to assess the effects of nanopolystyrene (nPS) and nPS with the sorbed co-contaminant Tributin (TBT) on free living nematodes on sandy sediment within a mesocosm experiment. Sediment was collected (up to 5 cm depth) at the Eden Estuary, St Andrews, Scotland, UK. The mesocosms (12°C) consisted of glass beakers (1 L) and the exposure took place for up to 2 months. Core samples of sediments were taken each week from the following treatments: 1) Control sediment, 2) Sediment with spiked TBT (0-100 ng/kg), 3) Sediment with nPS (0-12 mg/kg) and 4) Sediment with nPS spiked with TBT (0-10 mg/kg nPS). Oxygen penetration depth (OPD) was determined by measurement of the oxygen saturation in the sediments using a microprofile equipped with oxygen microsensors. Changes in the nematode community structure were measured by assessment of changes nematode diversity (nematodes identified to genus) and dose responses analysed according to nPS and TBT concentration of the sediments. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

**TH025 Impacts of exposure to microplastics alone and with adsorbed benzo(a)pyrene on biomarkers and scope for growth in marine mussels**

J. Hatfield, N. González-Soto, University of the Basque country UPV/EHU; A. Katsumiti, University of the Basque country / CBET Research Group; Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Duroudier, University of the Basque country UPV/EHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Navarro, University of the Basque country UPV/EHU; M. P. Cajaraville, University of the Basque country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE;

Due to their hydrophobicity and relatively large surface area, microplastics (MPs) can act as carriers of hydrophobic pollutants in the ocean and may facilitate their transfer to organisms (so-called “Trojan-horse effect”). This study examined the effects of different levels of biological effectors (0.5 and 4). Further, we used the sorbed benzo(a)pyrene (BaP) on mussels Mytilus galloprovincialis in order to elucidate the effects of MP size and the presence of adsorbed contaminants on the organism. MPs were provided daily, mixed with algae, at 1000 particles/ml/day, during 7 and 26 days. Effects were determined on early cellular biomarkers (catalase activity [CAT], neutral red uptake [NR] and DNA damage in hemocytes; histopathology in digestive gland) and on ontogenetic responses (scope for growth [SGF] and condition index). Chemical analysis showed that BaP concentrations in mussels increased with time (up to 150 times greater than background levels) and that smaller MPs pose an increased hazard in terms of the transfer of adsorbed BaP. In histology, large MPs were abundant in the lumen of stomach, mixed with stomach contents, and in the lumen of digestive tubules (DTs), associated to cell debris. Occasionally they appeared within epithelial cells of the stomach, ducts and DTs and in the connective tissue. Small MPs were also abundant in the lumen of stomach. In all samples, DT appearance indicated a high digestive activity, confirmed by hexosaminidase histochemistry. Overall, effects in all treatments increased with exposure time. Increased effects of MPs+BaP compared to MPs alone were seen in NR and DNA damage in hemocytes. In digestive gland, BaP effects were observed at both of the concentrations tested. An increased effect of smaller MPs on DNA damage was also found. A general horneric effect was demonstrated on SFG across MP treatments. This may be due to a compensatory effect whereby mussels increased their absorption efficiency in order to increase energy intake to make up for energy used dealing with stress observed in biomarker responses. This evidenced a link between MP exposure and the performance of zebrafish larvae, indicating a potential for UC-MP interactions.
supernatant by SPME/GC/MS. To measure BaP adsorbed to the plastics (A-BaP), plastic solutions were freeze-dried and subjected to microwave-assisted extraction before GC/MS analysis. The adsorption capacity of the plastics was calculated in mass of adsorbed BaP per gram of plastic (µg g⁻¹) for the different sizes of plastic in order to determine the capacity of adsorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that the adsorption capacity of A-BaP for adsorption of POPs was 2.19 µg g⁻¹ for 0.5 µm MPs. The percentages of adsorbed BaP from each of the BaP solution were 90.88% and 37.18% with a Qo₀ of 217.39 µg g⁻¹ and 18.33 µg g⁻¹ (Langmuir model); R² = 0.9862 (0.9477) for 0.5 µm and 4.5 µm MPs, respectively. In both cases the applied methodology was successful to characterise the adsorption process of BaP to MPs and is currently being applied to NPs. * Funded by French ANR (N° 10 BP03-02) and Cluster for Excellence COT (ANR-10-LABX 45), Spanish MINECO (NACE project — CTM2016-8130-R), Basque Government (consolidated research group IT510-13) and UPV/EHU (UI 11/37 and grant to IM).}

**TH027 Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord**

*a. bour*, ECOLABUMRS254 CNRS UPS I3P; C.G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Polytechnic University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences

The exponential production and use of plastics has generated millions of tons of plastic waste over the past decades, and the presence of microplastics has been reported throughout the world’s oceans. The ingestion of microplastics in situ has been shown in various species, but important knowledge gaps remain, as most studies focus on pelagic fish species or bivalves used for human consumption. Here, we report the presence of microplastics in ten sediment-dwelling and epibenthic species representative of different feeding modes and trophic levels. The species analyzed include fish, bivalves, echinoderms, crustaceans and polychaetes. Organisms were sampled in the inner Oslofjord (Oslo, Norway), which is a fjord subject to strong anthropogenic pressures. High occurrence of plastic contamination was observed, with microplastic particles found in all species and in half of the individuals on average, and present in 75% of the individuals for some species. The extracted microplastics had various shapes (fibers, fragments, flakes), colors and sizes. Micro-FTR-IR analysis revealed the presence of various plastic polymers: polyethylene, polypropylene and polyamide which were the most commonly found, with 37%, 25% and 15% respectively. We hypothesize that maritime and fishing activities are the main source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polyamide, polyacrylic, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

**TH028 Development of an optimal analytical protocol for the extraction of persistent organic pollutants adsorbed on plastic debris in the environment**


Accumulation of persistent organic pollutants (POPs)-loaded microplastics (MPs) in the aquatic milieu is an emerging issue of international concern. Qualitative/quantitative determination of POPs on MPs is essential for the estimation of the impact of POPs-loaded MPs on a range of marine organisms. In general, hydrophobic pollutants like POPs are first extracted from the matrix, in this case plastic debris, using non-source-of-release solvents. Then, the microparticles will be cleaned-up and analysed in e.g. gas chromatography/mass spectrometry (GC/MS). Some non-polar solvents applied for POP extraction, however, may dissolve plastic debris partially or completely, which disturb subsequent analyses. A number of methods have been reported for the extraction of POPs from MPs. Yet, the validity of these methods have not been fully discussed and the influence of polymers in extraction solutions, in subsequent POP analysis has not been thoroughly investigated. The goal of the current study is the development of an optimal analytical protocol to extract POPs from different MPs. Known amounts of POPs were artificially charged on the surface of selected polymer particles, including preproduction resin pellets from different polymer type (polyethylene, PE; polystyrene, PS; polyethylene terephthalate PET, propylene, PP; poly vinyl chloride, PVC) in the laboratory. The POPs on plastic particles were extracted in selected solvents using soaking and sonication methods under different conditions. Solvents used in this study include n-hexane (nHex), isopropanol (iProH) and dichloromethane (DCM). Extraction methods and conditions were evaluated for a high extraction recovery, a high reproducibility, as well as for a minimal damage of polymer particles, i.e. carriers of POPs. The recovery rate and analytical reproducibility of POP was determined using gas chromatography-mass spectrometry (GC/MS). The loss of plastic weight was measured for the evaluation of the stability of plastic particles under given extraction conditions. Further, we investigated the influence of polymers dissolved in solvent on quantitative analysis for POPs. TU Darmstadt and CARAT are participants of an EU project “PLASTOX”, a consortium of a JPI Oceans’ Joint Action. TU Darmstadt is funded by BMBF.

**TH029 Comparison of spiking and dialysis tubing methods for the determination of sorption capacity and plastic-water partition coefficient of three different polymeric hydrocarbons on microplastics**


Determination of sorption capacity of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aqueous environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polycyclic aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3 ), phenanthrene (log Kow = 4.46 ) and fluoranthene (log Kow = 5.16 ). The plastic samples tested here are LDPE pellets with low amount of additives. LDPE pellets were previously characterised by CARAT GmbH (Bochum). For the spiking method, batch reactors containing given amount of LDPE and MilliQ water were prepared. A high concentration of single PAHs in ethanol solution was injected into each batch reactor until the PAH concentration became stable. PAH concentration in the batch was controlled using high performance liquid chromatography (HPLC). For the dialysis tubing method, on the other hand, a closed dialysis tubing (permeability of 12,000-14,000 Dalton) containing a given amount of LDPE and MilliQ water was placed in each batch reactor filled with MilliQ water with single PAHs far above solubility. The water concentration outside of the tubing was expected to stay constant (= water solubility) during the entire experiment. The PAH concentration in the dialysis tubing was controlled using HPLC until the PAH concentration became stable. All batch reactors were placed on a horizontal shaker. When the adsorption of PAHs is completed, PAHs on LDPE are to be extracted and quantified using gas chromatography-mass spectrometry (GC/MS). Sorption capacity of each PAH was derived from the experiments and methods were compared. PE-water partition coefficient of these PAHs were derived based on the sorption capacity using adsorption models. TU Darmstadt and CARAT are participants of an EU project „PLASTOX“, a consortium of a JPI Ocean’s Joint Action.

**TH030 Microplastics in food and beverages - a distorted perspective on risk**

S. Risg, DTU (Technical University of Denmark) / Department of Environmental Engineering; B.C. Almroth, University of Gothenburg / Department of Biological and Environmental Sciences, Tufts University; T.M. Karlsson, University of Gothenburg

Microplastics are ubiquitous in aquatic environments and they are ingested by a wide range of animals, including species for human consumption, i.e. bivalves and fish. Additionally, plastic particles have been reported in other food products and beverages, like honey, salt, beer and drinking water. This has triggered a discussion on the human health implications of this contamination – an aspect that has gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which merely show the presence of microplastics in certain products but no actual effects on humans. It is without question that plastics can constitute a human health risk, however, to participate by partially toxic. However, the degree to which microplastic exposure via food products and beverages contributes to this health risk is likely insignificant at present time. When considering the magnitude of plastic usage and consequential exposure to plastic materials in our everyday lives, the relatively few microplastic particles that have been reported in food products and beverages will likely only constitute a minor exposure pathway for microplastics and associated chemicals. But as this is rarely put into perspective, the current debate creates a distorted picture of plastic exposure and risks to humans, resulting in a misdirected outrage when people find out about plastic particles in fish, while they at the same time not reflect on the plastic container in which the fish is packaged for transport to stores and homes. In this way, the focus is taken away from the root of the problem, namely our use, consumption and disposal of plastic materials. We therefore want to encourage a more balanced and careful discussion on human health implications of plastics that takes these aspects into account.
Is the Arctic threatened by plastics? Identifying sources and determining the distribution of microplastics around Svalbard

Where is all the plastic, and what concentration of microplastics are ecosystems being exposed to? These are puzzling questions to the scientific community when comparing estimated values on annual plastic pollution with the actual measurements in the world’s oceanic habitats. Recent investigations find plastic far away from any major plastic production, such as in the deep ocean sediments and bottoms within the polar sea ice. The Arctic Ocean has, despite its remoteness, been suggested as a sink for plastic. Fed by the thermohaline circulation driven deep-water formation, the Arctic Ocean’s bottom might be a dead end for plastics. However, very few studies have quantified the actual environmental concentrations of plastics in this remote area, thus the exposure to organisms living in this environment and potential effects are unknown. In this study, we investigated the occurrence, potential sources, and distribution of microplastics in the Norwegian Arctic. We quantified and characterized anthropogenic particles >10μm in different environmental compartments (sediment, water, benthic invertebrates and sea ice) around the western and northern coasts of Svalbard. Samples were collected close to a sewage outlet and far from human activities close to the sea ice front in the Arctic Ocean. By sampling at several depths throughout the water column, microplastics associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic matter tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and seaweed (copropstanol) enabled correlations to be made on potential sources, pathways and fate of microplastics in the Arctic. Additional analyses of the presence of plastic specific contaminants in sediment and biota facilitated a discussion on potential exposure independent of particle accumulation in the gut. One of the primary objectives of the investigation was to determine the relative importance of local and remote sources for plastic contamination in the Arctic, and preliminary results indicate a clear signal from local sources and sea ice. In order to evaluate the risk posed by microplastics in the Arctic, a risk assessment model is needed, but currently, this risk assessment is burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

Microplastics - an ecotoxicological issue? How to balance facts and perception without marginalizing an environmental problem

C. Volberg, ISOE - Institute for Social-Ecological Research / Water infrastructure and risk analyses; J. Kramm, ISOE - Institute for Social-Ecological Research While plastic has been known as a factor for environmental pollution – symbolized by the plastic bag – for a long time, recent scientific evidence on the massive accumulation in the oceans and the environmental risks associated with microplastics in the Arctic has gained public interest. The new findings revealed that microplastics are ubiquitous in the marine environment and can be found both at the surface and in the sediments. They are present in the Arctic Ocean and in the Barents Sea, and they are also found in the Baltic Sea. The plastic particles are small and therefore difficult to remove from water bodies. This means that there is a risk that plastic particles can be ingested by marine organisms and end up in the food chain. The plastic particles can also have toxic effects on marine organisms and ecosystems. There is a need for better knowledge about the fate and effects of plastic particles in the Arctic Ocean. This knowledge can help to prevent the problem from becoming even worse.
the accumulation and tissue distribution of eight common OPs, and their four DAP metabolites in three freshwater fish species from locations around Beijing, China. Accumulation of DAPs were relatively lower but comparable to those of PFRs in freshwater fish. DAPs had low affinity to lipophilic tissue in fishes, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of PFRs and DAPs than the other tissues of fish. It suggested the existence of a specific mechanism for the elimination of PFRs and DAPs in wild animal studies. In the subsequent laboratory control study, we screened the metabolites of alkyl-PFRs by in vivo exposure of Gobiobryps rarus. Metabolites of alkyl-PFRs in fish liver after 30-day exposure were analyzed with UPLC-QTOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxylation, dihydroxylation, desaturation, and phase II glucuronide conjugation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BOHOEP, and 3-OH-TNBP formed in fish liver microsomes. Liver rather than intestine, plays the primary role in PFR clearance in fish. The significance of these metabolites is in good agreement with human urine monitoring and in vivo rat exposure studies. Overall, the results emphasized the importance of hydroxylated metabolites as biomarkers for alkyl-PFRs exposure.

TH036
Bioaccumulation and biotransformation of prochloraz in the aquatic invertebrate Hyalella azteca
D. Fedrizzi, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; A. Rösch, Eawag / Environmental Chemistry; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry
Prochloraz is a widely applied fungicide for pest management purposes. Due to spray drift and surface runoff, prochloraz enters the aquatic environment where it can pose a risk to invertebrate organisms. It has been recognized as a model organism to test toxicity of organic chemicals due to its rapid life cycle, the feasibility of cultivation and its sensitivity to xenobiotics. Biotransformation is a primary detoxification process through which organisms defend themselves from xenobiotics. Biotransformation can reduce the internal concentration of parent compounds but affects their bioaccumulation. The aim of this study was to assess the toxikoecinetics of prochloraz and its biotransformation products (BTPs) in Hyalella azteca. Adults of Hyalella azteca were exposed to prochloraz at the concentration of 100 µg L⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase following a decrease during the depuration phase. The biaccumulation factor was calculated to be 110 L kg⁻¹. Finally, the data will be modeled using a toxicokinetic model and the bioaccumulation and transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in Hyalella azteca.

TH037
Toxikoecinetics and metabolite identification of two emerging pollutants, Acesulfame-K and 4-MBC, in the manila clam Ruditapes philippinarum
N.C. Ruiz, INMAR - University of Cadiz / Physical Chemistry; F. Tonini, Alma Mater Studiorum - University of Bologna; P. Lara-Martín, University of Cadiz / Physical Chemistry; J. Blasco, Inst. Ciencias Marinas de Andalucia / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR - University of Cadiz
Marine ecosystems have been historically sinks for many pollutants and chemicals whose effects awoke social concern, triggering the implementation of legislations. Nowadays, new compounds are developed at increasing rates and eventually discharged into marine ecosystems in unknown quantities and with no regulation. Due to the improvement of new analytical techniques, many of these chemicals, the so called “emerging pollutants” (EUPs), are becoming currently identified and their occurrence is being showed in the environment. However, very little is known about the possible adverse effects of these emerging pollutants in exposed non-target organisms. In this context, the present work evaluates the toxikoecinetics (TK) of two EUPs (the UV filter 4-Methylbenzylidene-camphor (4-MBC) and the artificial sweetener acesulfame K (ACE-K) in the Manila clam Ruditapes philippinarum, focusing on determining the bioaccumulation factors (BCF) and identifying, monitoring and quantifying the metabolite production. Sixty adult clams were exposed for 7 days of exposure and 3 days of depuration, target compounds were extracted from both water phase and organisms and their concentrations were measured by liquid and gas chromatography coupled to tandem mass spectrometry (UPLC/GC-MS/MS). Additionally high resolution mass spectrometry (HRMS) and automated data analysis software (Metabolynx™) were used to identify possible TPs in the tissue of the Manila clam at different nominal concentrations (from 1 to 100 µg L⁻¹). For the UV filter, the estimated BCFs were between 61 553 and 539 13 1 L kg⁻¹, and several metabolites were identified, such as the reduction or hydroxylation of the compound. On the other hand, the artificial sweetener BCF was consistently lower, around 7 L Kg⁻¹ and no metabolites were identified. These results suggest that 4-MBC was highly bioaccumulated and metabolised to facilitate its excretion and they are directly related to the physicochemical properties of the target EUPs, since ACE-K is highly soluble in water (log ρₜ₀₂ 1.33) and excreted unchanged in comparison to the very hydrophobic UV filter (log ρₜ₀₂ 5.92). Additionally, the present study provides important information about the toxicokinetics of 4-MBC and ACE-K, which will be useful for understanding the mechanism of action of these compounds. Furthermore, this work demonstrates the potential of the UPLC-GC-HRMS approach using Metabolynx™ software for fast and accurate identification of metabolites of EUPs.

TH038
Organophosphate Esters, Including Alkyl-Substituted Triphenyl Phosphates, in East Greenland Polar Bears and Ringed Seals: Adipose Tissue Concentrations and In Vitro Deposition and Metabolite Formation
A. Strobel, Carleton University; W.G. Willmore, Carleton University / Biology department; C. Sonne, R. Dietz, Aarhus University / Department of Biosciences, Arctic Research Centre; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division
High concentrations of OPs have been reported in Arctic air (particles) while very little is known for wildlife although recent reports for Hudson Bay polar bears (Ursus maritimus) indicate that OP residue levels in fat tissues are very low or non-detectable and appear to be strongly influenced by biotransformation. In the present study, the hepatic in vitro metabolism of six environmentally relevant organophosphate (OP) triesters and corresponding OP diester formation were investigated in East Greenland (Scoresby Sound region) polar bears (PBs) and ringed seals (RSs; Pusa hispida). The in vitro OP triester metabolism assay results were compared to fat (adipose) levels of selected OP triesters in field samples from the same individual animals. In vitro OP triester metabolism was generally rapid and structure-dependent, where PBs metabolized OPs more rapidly than RSs. Exceptions were the lack of triethyl phosphate metabolism and slow metabolism of tris (2-ethylhexyl) phosphate in both species. OP diester metabolites were also formed with the exception of triphenyl phosphate (TPHP) which was not metabolized at all in the RS assay. Tris (1,3-dichloro-2-propyl) phosphate was completely converted to its corresponding diester. However, the mass balances showed that OP diester formation corresponding to tris (2-ethylhexyl) phosphate, tri (n-butyl) phosphate, and tri (2-butoxyethyl) phosphate did not account for 100% of the OP triester depletion, which indicated alternate pathways of OP triester metabolism. TPHP was completely converted to its OP diester metabolite in PBs but not in RSs suggesting species-specific differences. Alkyl-substituted TPHP analogues also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

TH039
Proteomics of a metabolic simulation system - a look inside rat S9
A. Schiwy, EWOMIS; B. Thalmann, RWTH Aachen University, Institute for Environmental Research / Bios 5 - ESA; P. Huesgen, Forschungszentrum Jülich GmbH / Central Institute for Engineering, Electronics and Analytics (ZEA); S. Schiwy, Institute of Environmental Research/RWTH Aachen / Department of Ecotoxicology and Risk Analysis; H. Knabben, RWTH Aachen University / Institute for Environmental Research
The liver is the key organ in metabolism and detoxification of xenobiotics. Simulation of this organ in various bioassays is achieved via the application of either single cytochrome P450 enzymes produced via biotechnological processes or complex enzyme mixtures obtained from animals. Especially, this second process is regarded under various animal welfare regulations as an animal experiment. The animals have to be maintained to a specific age and following their livers have to be induced via various chemicals. Furthermore, this treatment may cause pain to the animals. Finally, the animals have to be killed to harvest the organ (predominantly liver) for further downstream processing. The most common procedure is a mincing of the organ and subsequent species-specific differences. Alkyl-substituted TPHP analogues also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

TH040
A critically evaluated database of in vitro and in vivo toxicokinetic data for
Toxicokinetics (TK) plays an important role in ecological and human health assessments. TK parameters can be determined by measuring TK data in all organisms (e.g., humans, rodents, fish) and there is a recognized need to reduce animal testing. Reliable (evaluated), high-quality existing in vitro and in vivo TK data could help evaluate in vitro-in vivo extrapolation models (IVIVE), parameterize TK and bioaccumulation models, and develop and validate quantitative structure-activity relationships (QSARs) for predicting TK parameters from chemical structure. Biotransformation and elimination rate data can be used in diverse contexts for chemical assessment. For example, biotransformation rate constants (k<sub>b</sub>) are key determinants and sources of uncertainty in bioaccumulation assessment. k<sub>b</sub> can be determined in vivo with whole animal models or from in vitro assays using intact cells or subcellular fractions from the liver or other tissues (e.g., gastrointestinal tract, kidney). We have developed a new database (funded by the JRC CCR.F.C931336.X0I) containing TK data (i.e., biotransformation rates) for fish and mammal species (i.e., rat, mice) derived from in vivo and in vitro (59 fraction, hepatocytes, microsomes) methods. The database entries are scored based on a data quality evaluation. The data quality assessment methods and criteria have been developed from standardized testing guidelines when such guidance exists and from professional judgement in the absence of standardized guidance. In total the new database includes approximately 9000 entries for organic chemicals. There are approximately 4000 and 400 chemicals from in vitro and in vivo studies respectively from rodent species. There are approximately 120 and 700 chemicals from in vitro and in vivo studies respectively from fish species. The database can be used as a source of information for chemical assessments and can help identify future research needs (i.e., chemicals that require chemical evaluation and for which reliable quality data are not available). We believe the database will also be a valuable source information for model developers (e.g. for in vitro-in vivo extrapolation models, kinetic models, models to predict exposure and internal concentration in an organism) and chemical evaluators. The database will be publicly available at the Joint Research Centre website.

**TH041**

A tiered testing strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate constants for aquatic and terrestrial organisms

K. Schirmer, Eawag / Environmental Toxicology; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; N. Bramaz, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; M. McFadzean, ILSI Health; Schoenenberger, University of Bern / Centre for Fish and Wildlife Health; H. Segner, University of Bern / Centre for Fish and Wildlife Health; R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Studnicka-Michalak, EPFL - Swiss Federal Institute of Technology

Our research seeks to improve alternative methods to estimate bioaccumulation of organic chemicals in fish. We follow a tiered strategy that integrates toxicokinetic (TK) models, quantitative structure-activity relationships (QSARs), in vitro experiments (e.g., gill and test tube), and in vivo bioaccumulation tests. In the first step, we derived a list of candidate chemicals for in vitro testing based on model discrepancies, availability of reliable in vivo BCF and BMF data, and availability of in vitro biotransformation rates. The resulting chemicals were divided into three K<sub>a</sub> categories based on predominantly endogenous exposure route(s) to guide in vitro testing: 1) log K<sub>a</sub> > 6 (aqueous exposure dominates – to be tested in gill and liver models); 2) 3 log K<sub>a</sub> > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>a</sub> < 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support to guide in vitro testing: 1 log K<sub>a</sub> > 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K<sub>a</sub> > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>a</sub> < 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support to guide in vitro testing: 1 log K<sub>a</sub> > 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K<sub>a</sub> > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>a</sub> < 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support to guide in vitro testing: 1 log K<sub>a</sub> > 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K<sub>a</sub> > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>a</sub> < 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support to guide in vitro testing: 1 log K<sub>a</sub> > 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K<sub>a</sub> > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>a</sub> < 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support to guide in vitro testing: 1 log K<sub>a</sub> > 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K<sub>a</sub> > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>a</sub> < 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models).

**TH042**

Update on development of OECD Test Guidelines and Guidance Document on determination of fish in vitro hepatic clearance


Toxicokinetics (TK) have developed a new database containing TK data (i.e., biotransformation rates) for fish and mammal species (i.e., rat, mice) derived from in vivo and in vitro (59 fraction, hepatocytes, microsomes) methods. The database entries are scored based on a data quality evaluation. The data quality assessment methods and criteria have been developed from standardized testing guidelines when such guidance exists and from professional judgement in the absence of standardized guidance. In total the new database includes approximately 9000 entries for organic chemicals. There are approximately 4000 and 400 chemicals from in vitro and in vivo studies respectively from rodent species. There are approximately 120 and 700 chemicals from in vitro and in vivo studies respectively from fish species. The database can be used as a source of information for chemical assessments and can help identify future research needs (i.e., chemicals that require chemical evaluation and for which reliable quality data are not available). We believe the database will also be a valuable source information for model developers (e.g. for in vitro-in vivo extrapolation models, kinetic models, models to predict exposure and internal concentration in an organism) and chemical evaluators. The database will be publicly available at the Joint Research Centre website.

**TH043**

The Bioaccumulation Assessment Tool (BAT): A quantitative weight of evidence approach for bioaccumulation assessment

L. Teene, ARC Arnot Research & Consulting; J.M. Armitage, University of Toronto - Environment & Sustainability Research Centre; K. Schirmer, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University. Applications of Modelling & Quantitative Methods (AMOD); M. Embry, ILSI; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Chemicals are being assessed for bioaccumulation (B) potential in regulatory programs using various methods, metrics and criteria. B data can be obtained from various data streams including laboratory studies, field studies and model predictions using mass balance models and quantitative structure-activity relationships (QSARs). Examples of bioaccumulation metrics include: the bioconcentration factor (BCF), bioaccumulation factor (BAF), biomagnification factor (BMF), and fish tissue factor (FTF). The Bioaccumulation Assessment Tool (BAT) collect, evaluate and integrate various species of evidence (LOE) associated with these B-metrics and related B classification criteria to aid decision-making. The BAT provides a transparent and consistent framework for evaluating neutral and ionizable organic chemicals in aquatic and terrestrial organisms. It uses a quantitative weight of evidence (QWOE) approach which includes evaluations for the relevance, reliability (confidence) and outcome of each B-metric. Each substantive LOE (e.g., BCF, BMF, biotransformation rate) is subject to data quality evaluation resulting in a data confidence score. The Data Evaluation Templates (DETs) have been derived from standard test protocols and expert judgment when standard protocols are not yet developed. Physical-chemical properties can be used or the user is allowed to enter biologically relevant partition coefficients in place of default assumptions that assume octanol as surrogate for biological components (i.e., lipid). Estimates for biotransformation rates can be included from in vitro assays (i.e., S9, hepatocyte, microsomal) and from in silico (QSAR) predictions. Empirical data such as lab BCFs and BMFs and field data as
as in silico data (e.g., BCF-QSARs) can be included in the QWOE. This presentation provides an overview of the BAT and demonstrates its application with two case studies. The first example is a typical “data poor” scenario in which only chemical structure information is available. From chemical structure relevant physical-chemical property and biotransformation rate data are obtained from QSARs and entered into the system. The second case study is for a relatively data rich compound. For this example, in addition to the in situ data and the EFs, there also exist several databases (e.g., 3 lab BCFs, various BCF-QSARs, biotransformation rate QSARs, in vitro biotransformation rates). Future work for improving the BAT is discussed.

TH044 Towards the use of elimination rates in bioaccumulation assessment – Current challenges and future trends

G. Treu, German Environment Agency / REACH Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; C. Rauert, Umweltbundesamt / International Chemicals Management

The capacity of chemicals to bioaccumulate in biota is recognized as critical property that contributes to a chemicals risk. The bioconcentration factor (BCF) reflecting the uptake of a chemical from water and the biomagnification factor (BMF) following dietary uptake in fish remain the preferred metrics in bioaccumulation assessment. The test systems are expensive, time consuming and are not suitable for screening purposes. Still, terrestrial bioaccumulation is hardly considered. A comprehensive bioaccumulation assessment should consider both, the aquatic and terrestrial organisms. Recently, it has been suggested that BCF and BMF can be derived by only determining the elimination rate constant (ki) experimentally while the uptake rate (k1) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to ki is from in vitro experiments while the effect of the other pathways (excretion via urine and feces, and ventilation) are estimated with in vitro to vivo extrapolation models. Biotransformation often reduces the extent to which chemicals accumulate in fish and mammals. Thus, a Tier 1.5 can be introduced between Tier 1 (screening based on physico-chemical data) and Tier 2 (exposure studies with animals) where in vivo biotransformation rates (ki) obtained from in vitro tests with fish or mammalian cells are extrapolated to whole organisms and then incorporated into to existing chemical mass-balance models to predict a BCF or BMF. Only if this model indicates an increased bioaccumulation a potential a higher-tier vertebrate test is then needed. In practice, animal tests are mandatory for chemicals exceeding a certain level of hydrophobicity but may turn out as non bioaccumulative due to metabolism. A ki based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro koi different tissues, e.g. gills, liver and gastrointestinal tract, could be serve as alternative screening criterion under REACH. This approach not only will better experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionic substances, and should be addressed in future research by taking into account specific metabolic pathways. This poster aims at demonstrating current limitations and future needs for the ki based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

TH045 SETAC Bioaccumulation Science Interest Group

L.P. Burkhard, U.S. EPA / ORD/NHEERL/Mid-Continent Ecology Division

Advances in evaluating and regulating endocrine disruptors (P)

TH046 Progress of the Japanese Program on Endocrine Disrupting Effects of Chemicals: EXTEND2016

K. Yamazaki, Ministry of the Environment / Environmental Health Ministry of the Environment, Japan published its fourth program on endocrine disrupting effects of chemical substances “EXTEND2016” in June 2016. It is developed upon achievements on development of framework, development and improvement of test protocols and implementation of testing and assessment in the preceding program “EXTEND2010”. While basic concepts and framework was inherited from EXTEND2010, EXTEND2016’s focus has been shifting to implementation of testing and assessment and consideration of appropriate risk management measures. During fiscal years 2016-17 progress has been made in development of test protocols, evaluation of existing knowledge, identification of candidate chemicals for testing, implementation of testing and assessment and communication to the public, as well as in international collaborative projects with the United Kingdom and the United States. One of the most significant achievements should be finalization of the data obtained from the medaka extended one generation reproduction test (MEOGRT) for 4-nonylphenol, which are expected to be referred to in regulatory environmental risk assessment. The reproduction tests are being conducted for additional chemicals within the program. Updated progress in testing and assessment under EXTEND2016 will be presented at the Annual Meeting.

TH047 Effects of endocrine disruptors on reproductive health: A new approach to integrating ecotoxicological and human health data

L. Parent, Télé-université / UER Science et Technologie; P. Grigorova, Université TELUQ / Département Science et Technologie; M. Nikolaros, Université TELUQ / Science et Technologie

Exposure to synthetic and natural chemicals is almost inevitable in our daily lives. Some of them raise concerns with their endocrine disruptive potential and possible interference with endocrine system leading to the variety of adverse health effects. It was initially through clusters of presumptions that the potential effects of endocrine disruptors (EDs) on human health and the environment were highlighted. EDs, as a growing source of concern, now need to better document the complexity of their relationship between exposure and effects, hence the development of new evidence-based approaches to better document decision-making in health policy. Among these approaches, we retained the systematic reviews, based on objective methods, to integrate multiple sources of evidence (epidemiology, wild animals, laboratory animals, in vitro and in silico data) relevant to the evaluation. Our project aims to systematically review the data published the last 10 years linking the existence to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, fluorinated compounds) with the effects on the development and reproductive health as changes in sex ratio, congenital malformations, sperm quality disruption, alteration of plasma levels vitellogenin, sex hormone levels as well as anomalies of gonad development. 16 701 articles were screened and 744 met the inclusion criteria for the review. The data was extracted from 155 EU legal frameworks, 342 in fish studies, 377 in ecotoxicological studies and the ROB (risk of bias) analysis was performed for the relevant outcomes, confidence in the body of evidence for an effect was rated, and scores are given. In this presentation, we will show what is the strength of the evidence for the association between exposures and (adverse) effect, and we will discuss the role of ecotoxicological studies in the global analysis: prioritizing EDs, understanding mechanisms of action, establishing standards or impact criteria, identifying sensitive biomarkers and bioindicators for each of the EDs.

TH048 Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities

A. Kienzler, IREC / E3-F3-Chefalytical Safety and Alternative Methods Unit-ECVAM; Z. Dang, RIVM / LIEC CNRS UMR; S. van der Linder, IREC

In the last decade, with the increased awareness of potential effect of endocrine disruptors (EDs) on wildlife, fish toxicity test guidelines have been developed by administrative or regulatory agencies, such as the OECD TG 231 to test chemicals with estrogenic activity. However, only recently was the need for comparable guidelines to test chemicals with activity on the androgenic and steroidogenesis) activities. These tests have been summarized in the OECD guidance documents 150 and 171 and specific guidance on the diagnosis of endocrine-related histopathology in fish gonads is available (GD 123). However, while the relevance of fish toxicity tests is clear in the assessment of endocrine disruptors, comparison of these tests in response to EDs has not yet been made in those frameworks. In the present work these fish tests are evaluated on the basis of the existing information case by case. Due to a difference in sensitivity of species and life stages, many EU discussions have focused on which test should be suitable. However, due to practical considerations, (e.g. regional preference, practical use, and specifically sensitivity,) it is unlikely to meet all of the requirements within one test. But in order to avoid further additional testing, species selection should always consider most factors as much as possible. This work intends to summarise the pros and cons of the available test guidelines and to address some issues e.g. sensitivity in different life stages and in species. Available fish toxicity tests include test guidelines (TG) 229, 230, 234, 240 and guidance document (GD) 148. The number of fish used in each fish test, the covered lifespan, the investigated EDs-related endpoints, their robustness (and to which extend these have been validated) and the species sensitivity in response to chemicals with EAS modes of action will be compared. To this aim, publically available data on different fish species tested according to TGs or TG-like protocols will be collected and analyzed. Analysing these fish toxicity data will help identifying which fish test, which species, which life stage of test are needed for the identification and/or risk assessment of EDs. Based on the overall data analysis, we will propose an environmental testing strategy, which is important for minimizing vertebrate testing and costs.

TH049 Towards developing a list reference chemicals for endocrine assay validation

C. Prosser, ExxonMobil Biomedical Sciences, Inc.; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI)

Compared to other areas of human and environmental hazard assessment, evaluating the potential for endogenous compounds to interact with endocrine pathways is relatively nascent. However, recognizing the possibility of a public and environmental hazard, many national governments, international organizations, industry bodies, public interest groups and academic institutions established research programs to address the impacts of endogenous substances on the endocrine system. This has resulted in attempts to develop and validate a battery of
tests to screen for endocrine active compounds with multiple publications by both regulatory agencies and academics aiming at identifying appropriate in vitro and in vivo assays. Thus, there has been considerable effort to establish criteria and interpret results for the identification of potential of endocrine active compounds. However, despite all the attention on test development, little consideration has been given to establishing a list of reference compounds to be used in the validation process. Without establishing a set of criteria it may prove problematic to assess interlaboratory variability for the same endocrine mode of action (e.g. estrogenic/androgenic effects). When evaluating the current, validated, assays in OECD Guidance Document 150, there is a great disparity in the reference chemicals selected, and no discussion as to why various chemical were chosen for the validation procedure. Additionally, reference chemical selection is often not considered a strength and while the valid test results challenges to regulators and researchers in selecting assays with needed sensitivity and/or appropriateness of use. Here, we attempt to identify the parameters that should be evaluated when selecting validation chemicals. These range from simple physical/chemical properties, to more complex information related to a known mode of action. Additionally, reference chemicals used during assay validation should span a range of potencies incorporating both positive and negative controls. Some well accepted and commonly used chemicals are provided as a realistic starting point to compile a set list of reference chemicals for the validation of endocrine assays.

TH050
Assessment of endocrine disrupting properties of pesticides and biocides: data processing to support data analysis

In 2016 the Commission completed an impact assessment to estimate possible health, environmental and socio-economic consequences of adopting different options, formulated as scientific criteria, for identifying Endocrine Disruptors (EDs) under the Plant Protection Products Regulation and Biocidal Products Regulation. JRC developed a central element of this assessment, namely, a science-based methodology to screen over 600 chemicals in about 10 months, including all EU-registered biocides and pesticides. The methodology was based solely on already existing data. To achieve the objective of screening hundreds of substances in a limited time, all retrieved data for a substance (toxicological studies, effects observed, NOAEL, etc.) were captured in an excel template (consisting of 40 columns), developed by JRC, in order to systematically organise the information to then facilitate data-analysis. As a result a large and curated database is available summarising relevant existing data collected for the 600 substances screened. A major accomplishment was the development of an innovative way to process and visually represent the data captured in the excel template as a mean to facilitate the data analysis in a systematic manner and in medium-throughput to ensure meeting the objective defined in the Commission Roadmap of screening 600 substances in a limited time and by using high-quality science-based strategy. Briefly the data collected are re-organised and processed into a data-matrix which is built automatically after the template has been filled. The data-matrix, available for each of the reference chemicals in getting the same bioactivity and mechanistic potency information available for a certain chemical thus facilitating the data analysis to identify EDs. For instance the data-matrix visually reports if certain toxicological endpoint has been observed across different studies to support evaluation of consistency and reproducibility of toxicity findings. Focusing on all the pesticides and biocides screened (about 400 substances), the data-matrix for all these substances were merged together in order to build a heat-map summarising all the toxicological information collected by endpoint. The heat-map can be used to group chemicals based on the similarity of their toxicological behaviour as a mean to prioritise chemicals for further analysis or to build read-across strategy to fill data-gaps.

TH051
Assessment of endocrine disrupting properties of pesticides and biocides: data requirements, availability and needs

Before pesticides and biocides are allowed to enter the European market, a minimum set of toxicological data is required to be submitted in order to evaluate their (unintentional) toxicity and approve their use. In case of concern(s), specific conditions may apply to limit their use or approval might not be granted at all. The data that is required to be submitted is (mostly) coming from standardized test guidelines (TGs). While these TGs focus on a diverse range of toxic effects, none of the TG studies currently in the data requirements are specifically developed for the assessment of endocrine disruption (ED). However, ED specific findings can potentially be extracted from these studies and supplemented with data coming from other sources. OECD Guidance Document 150 can help with the ED specific interpretation of data and a guidance document for assessing pesticides and biocides is currently being developed by EFSA, ECHA and JRC. In the context of the recent ED impact assessment, we screened the regulatory dossiers, scientific literature and other available EDs and categorise all pesticides and biocides currently registered in the EU. This assessment will be used as a basis for a human and environmental health. This presentation will provide an overview of the results of this categorisation, combined with indications of the origin of the data driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.

TH052
Plausible or Causal: Bioactivity and mechanistic potency as a critical piece in hazard characterization of endocrine active chemicals
E.M. Milhau, ER2; K. Plötzke, Debt Chemical Company / Toxicology; E. Arnin, German Environment Agency UBA; E. Hassold, German Environment Agency UBA / IV 2/3 Chemicals; S. Germer, German Environment Agency UBA

While methods have been and are being developed and validated, and regulatory programs around the world are moving forward with evaluating chemicals for their potential interaction with the endocrine system of humans and wildlife, the challenge still remains in distinguishing between effects that are specifically estrogenic and those that are considered as only a mode of action (MoA). Under certain legislations, understanding the potential MoA is particularly important because regulatory decisions might categorize a substance as an endocrine disruptor (ED) through a hazard characterization process rather than taking into consideration exposure and risk. The WHO/IPCS definition of an endocrine disruptor requires that a substance alter the function of the endocrine system in an intact organism. Pathway models are being established that provide plausible links between molecular initiating events, key events and ultimately adverse effects. However, when several potential pathways or MoA converge on the same adverse effect in an intact organism it becomes challenging to identify the biologically plausible causal link between the MoA and the environmental or health effect of regulatory concern. The first part of the WHO/IPCS definition, that of the chemical acting through an endocrine MoA to alter the function of the endocrine system, focuses on the need for the substance to have sufficient affinity for and activity with components of the endocrine system, compared to endogenous hormones, in order to compete with the normal hormonal signaling and feedback mechanisms that maintain homeostasis. Additionally, if the compound acts through an endocrine-related bioactivity and the potential for a chemical to interact with the endocrine system, affinity and activity, also known as mechanistic potency, can be used in comparison to that of the endogenous ligands to support or reject the biological plausibility of a causal link between an endocrine MoA and an adverse effect. A hypothesis testing, weight of evidence framework and case study examples will be used to illustrate the use of bioactivity and mechanistic potency data, along with other lines of evidence, in the assessment of endocrine activity.

TH053
Addressing endocrine concerns for the environment in dossier evaluations with an FSID – possibility to avoid further vertebrate tests
F. Kaßner, Umweltbundesamt / Federal Environment Agency IV2.3 Chemicals; J. Arning, German Environment Agency UBA; E. Hassold, German Environment Agency UBA / IV 2/3 Chemicals; S. Germer, German Environment Agency UBA

In the context of the REACH regulation, long-term toxicity testing on fish is a standard information requirement for substances manufactured or imported in quantities of 100 or more tonnes per year. Additionally, some substance properties, for example a low water solubility, lead to the necessity to conduct a long-term toxicity test on fish. If a data gap in a registration for long-term toxicity to fish is identified in the process of a dossier evaluation (Dev), the preferred option is to request a Fish early life-stage Test (FELS - OECD 210). However for a substance with hints for endocrine disrupting properties, further tests would be needed to clarify the concern in a substance dossier. In this context, attempts were made to avoid additional vertebrate tests in a SEV by requesting a Fish Sexual Development Test (FSDT – OECD 234) as a standard long term fish toxicity test under dossier evaluation. This would make it possible to clarify the endocrine disrupting properties of the substance, if they are revealable in a FSDT, what is the case for most oestrogenic or androgenic acting chemicals. Similar to the FELS the FSDT assay provides an easy to use and well established test to avoid additional vertebrate tests in a SEV by requesting a Fish Sexual Development Test (FSDT – OECD 234) as a standard long term fish toxicity test under dossier evaluation. This presentation will provide an overview of the results of this categorisation, combined with indications of the origin of the data driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.
TH054 Structural Alerts for Potential Endocrine Disruptors
R. Kühn, N. Ost, Helmholtz Centre for Environmental Research UFZ / Department of Ecological Chemistry; L.A. Baumann, University of Heidelberg / Agricultural Geography and Toxicology; H. Segel, G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

Endocrine disrupting chemicals interact with the hormone system. They may trigger adverse effects on organisms. Endocrine disrupters are labelled as substances of very high concern (SVHC) and are subject of regulations as REACH. However, there are so far no internationally harmonised criteria for endocrine activity. Furthermore, the endocrine system is rather diverse. Existing tests are rather expensive, and it is still not clear whether they comprise all relevant pathways. Thus, the number of existing data is limited. In silico tools may provide alternatives at least to allow prioritisation of tests by screening compound lists. This study aimed at identifying structural alerts for potential endocrine disruptors of two relevant hormone systems, estrogen/androgen and thyroid hormones. Chemicals binding to the estrogen/androgen receptors may either yield an agonistic effect by mimicking the hormone, or an antagonistic effect by blocking the receptor site and thus preventing the hormones from binding themselves. Thyroid hormones bind to the ligand binding domain (LBD) of the receptor, and secondly binding of a co-activating protein to a part of the LBD (AF-2) triggers gene expression. Chemicals binding to LBD may again yield agonistic or antagonistic effects, for binding to AF-2 only antagonism is known. However, adverse effects to thyroid hormones can also result from other mechanisms as enzyme/protein interaction e.g. with the transporter protein and aly-1 hydrocarboxy-receptor interaction. Structural alerts to predict chemicals with potential effect on these systems have been developed. For the estrogen/androgen system a screening method has been refined. The model identifies 91% of the active chemicals, and false negative results are weakly active only. The models for LBD and AF-2 binding only miss one active compound. For other thyroid hormone effects a screening level model detects ca. 95% of the known active compounds, but there is suspicion of missing compound classes due to the lack of respective experimental data. Particular remark was given to characterize the applicability domain and reliability of the predictions. All models are implemented as automated tools in the software system ChemProp (UFZ Department of Ecological Chemistry 2017. ChemProp 6.6. http://www.ufz.de/coechem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 3714 63 412.0.

TH055 Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae
L. Birgersson, J. Sturwe, University of Gothenburg / Department of Biological and Environmental Sciences

Endocrine disrupting chemicals (EDCs) in the aquatic environment can have severe effects on the health of aquatic organisms as well as human health. Numerous anthropogenic EDCs, such as plasticizers, fire retardants and antibacterial agents, enter aquatic ecosystems from wastewater treatment plants and land runoff. Several of these have been shown to have adverse effects on fish, including disruption of reproduction, normal development and brain function. Previous studies have mainly focused on single compound exposures or simple mixtures and further evaluation of complex mixtures at low concentrations is needed. Within the framework of the European Horizon2020 project EDC-MixRisk, EDCs linked to adverse effects on neurodevelopment and growth in a pregnancy cohort study have been identified. Mixtures of these chemicals (phtalate metabolites, phenois and PFASs) were synthesized in a test to be tested in a range of in vitro and in vitro systems. The thyroid hormones (THs) are one of the targets of interest as they are essential for brain development and disruption of this axis may lead to alteration of neurodevelopment. The current study aimed to determine the effects of the EDC-mixtures on larval behaviour and to determine disruption of TH-related gene expression in zebrafish (Danio rerio) during early development. Zebrafish embryos were exposed to Mix N and Mix G (mixtures correlated with adverse effects on neurodevelopment or growth in the epidemiological study) for 48h in concentrations equivalent to 0.01x – 100x human levels. Alterations of larval behaviour caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be an sensitive end point for sub-lethal toxicity of endocrine disruptors. Larval locomotion was tracked using the ViewPoint ZebraBox and a protocol of alternating dark/light cycles. Quantitative PCR was used to determine the effects of the EDC mixture on the expression of thyroid related genes. Our results show that acute exposure to the mixtures significantly alter larval locomotion and expression of genes involved in TH signaling, including thyroid hormone receptors thra and thrb as well as the deiodinases Dio1 and Dio2 at concentrations corresponding to those found in pregnant mothers. These results will be combined with results from other model systems in the EDC-MixRisk project to improve risk assessment of EDC-mixtures.

TH056 Contaminants of emerging concern in the North American Great Lakes: Assessing environmental mixtures in multigenerational exposure studies
N. Cipoletti, St. Cloud State University / Aquatic Toxicity Laboratory; L. Wang, St. Cloud State University; H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

In aquatic ecosystems such as the North American Great Lakes watershed, organisms are exposed to complex chemical mixtures throughout life, producing effects not anticipated in laboratory settings designed to test acute effects of single chemicals. By exposing fathead minnows through three generations, we aim to capture exposure effects during sensitive life stages. Through two separate multigenerational studies, we analyzed the effects of both urban and agricultural co-occurring contaminants at environmentally relevant concentrations in the Great Lakes watershed. Fathead minnows were housed in a flow-through exposure system and propagated for three generations (approximately one year of continuous exposure). Larval fish were analyzed for predator avoidance performance, feeding efficiency, and growth. Adult fish were analyzed for fecundity, biological indices, and endocrinological characteristics (VTG, glucose). Both urban and agricultural exposures resulted in growth alterations between treatments most likely due to density-dependent growth. Urban exposure indicated higher fecundity (both first and second generation) at low and environmentally relevant concentrations as compared to control and high treatments, potentially as a therapeutic hazard associated with the estrogenic nature of the mixture. Agricultural exposure indicated lower fecundity, as well as endocrine disrupting effects concerns us. We identified typical CECs in rivers associated with agricultural and urban land use in the North American Great Lakes watershed. A mixture of agricultural CECs (AG) was assembled to mimic the environmentally occurring compounds and consisted of 8 chemicals, while an urban CEC mixture (UB) contained 11 chemicals including the known estrogenic compounds, bisphenol-A, estrone and nonylphenol in exposure concentrations. In addition to estrogenicities of CECs, Minnesota Pollution Control Agency reported that an exposure to CECs in the river water activated a peroxisome proliferator-activated receptor (PPAR/retinoid X receptor (RXR) pathway in the transcriptome analysis of fathead minnow. Our laboratory found that an exposure to CECs induced a higher incidence of hepatic vacuolization in fathead minnow, which would be an obesogenic effect of CECs via a PPAR/RXR signaling pathway. Two isoforms of estrogen receptor (ESR) of fathead minnow, bluegill sunfish, American alligator or human was examined in the human embryonic kidney 293T cells by quantifying their transcriptional activities using estrogen-response elements and luciferase reporter gene in an exposure to agricultural or urban CECs. Utilizing the same method in vitro, alligator PPAR-gamma and RXR-alpha were examined for both AG and UB mixtures were estrogenic, however, their estrogenicities varied depending on isoforms of ESRs and 4 species. Human ESR1 was the most sensitive to AG based on their estrogenicities, while minnow ESR1 was the least sensitive to AG. Bluegill ESR1 was the most sensitive to UB based on their estrogenicities, whereas BG ESR2 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate neither alligtor PPAR-gamma nor RXR-alpha. Although further investigations of PPAR/RXR signal are required in fathead minnow, PRARG/RXRA signals might not be involved in a CECs-exposure inducing a hepatic vacuolization in fathead minnow. These results indicate that efficacious receptors and species differ between CECs mixture, and further endocrine studies of CECs are required for a better understanding and prediction of CEC effects by utilizing a variety of receptors cloned from diverse threatened and endangered species.

TH057 Contaminants of emerging concern in the North American Great Lakes: Assessing species sensitivity to environmental mixtures
S. Kohno, S. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University / Aquatic Toxicity Laboratory; L. Wang, St. Cloud State University; U. Hasbay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concerns (CECs) have been detected ubiquitously in environmental samples, and their endocrine-disrupting effects concern us. We identified typical CECs in rivers associated with agricultural and urban land use in the North American Great Lakes watershed. A mixture of agricultural CECs (AG) was assembled to mimic the environmentally occurring compounds and consisted of 8 chemicals, while an urban CEC mixture (UB) contained 11 chemicals including the known estrogenic compounds, bisphenol-A, estrone and nonylphenol in exposure concentrations. In addition to estrogenicities of CECs, Minnesota Pollution Control Agency reported that an exposure to CECs in the river water activated a peroxisome proliferator-activated receptor (PPAR/retinoid X receptor (RXR) pathway in the transcriptome analysis of fathead minnow. Our laboratory found that an exposure to CECs induced a higher incidence of hepatic vacuolization in fathead minnow, which would be an obesogenic effect of CECs via a PPAR/RXR signaling pathway. Two isoforms of estrogen receptor (ESR) of fathead minnow, bluegill sunfish, American alligator or human was examined in the human embryonic kidney 293T cells by quantifying their transcriptional activities using estrogen-response elements and luciferase reporter gene in an exposure to agricultural or urban CECs. Utilizing the same method in vitro, alligator PPAR-gamma and RXR-alpha were examined for both AG and UB mixtures were estrogenic, however, their estrogenicities varied depending on isoforms of ESRs and 4 species. Human ESR1 was the most sensitive to AG based on their estrogenicities, while minnow ESR1 was the least sensitive to AG. Bluegill ESR1 was the most sensitive to UB based on their estrogenicities, whereas BG ESR2 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate neither alligtor PPAR-gamma nor RXR-alpha. Although further investigations of PPAR/RXR signal are required in fathead minnow, PRARG/RXRA signals might not be involved in a CECs-exposure inducing a hepatic vacuolization in fathead minnow. These results indicate that efficacious receptors and species differ between CECs mixture, and further endocrine studies of CECs are required for a better understanding and prediction of CEC effects by utilizing a variety of receptors cloned from diverse threatened and endangered species.

SETACE Europe 28th Annual Meeting Abstract Book
Contaminants of Emerging Concern in the North American Great Lakes: Load reduction and biological recovery after wastewater treatment upgrades

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; D. Martinez-Wiegelt, University of St. Thomas / Biology; P. Edmundson, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Many urban aquatic ecosystems are becoming effluent dominated, resulting in the presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominated urban systems support many ecosystem services and are used by the nearby human population for recreation. The Metropolitan Water Reclamation District of Greater Chicago upgraded two wastewater treatment plants (one million cubic meters/day each) to disinfection (UV; chlorination/de-chlorination). The receiving aquatic ecosystem adjacent to these two wastewater treatment plants has been the focus of intense biological and chemical study for the past seven years and provides a unique opportunity to assess two divergent treatment technologies (UV vs. chlorination/de-chlorination) and to examine how adverse biological effects in exposed fish may be mitigated through effluent disinfection. We exposed male fathead minnows (Pimephales promelas) in on-site flow-through exposure systems four times prior to the treatment upgrades and four times since to examine these questions. In addition, we conducted extensive analytical chemistry on effluent samples and employed in-vitro assays to examine overall biological activity of effluents prior and following disinfection treatment. Both disinfection methods transformed many CECs, in some instances reversibly (UV disinfection). UV disinfection resulted in enhanced maturity of male fathead minnows, and forming a linkage between behavioral responses and adverse outcomes.

TH061 Towards a multiparameter detection of biological effects caused by anthropogenic micro-pollutants

C.F. Reigard, German Federal Institute of Hydrology; L. Moscovici, The Hebrew University of Jerusalem / Institute of Life Sciences, Department of Plant and Environmental Science; G. Reifferscheid, German Federal Institute of Hydrology / Department G Biochemistry

Biological effects measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) endocrine disruptors used in polymers in the offshore oil and gas industry are based on monomers that are known and biodegradable substances and might therefore show that at least one of the analysed products has a high potential for releasing EDs and biodegradation and were tested using a Yeast based estrogen screen (YES) and a bacterial screening method (E-test). The project “TREE5”[1] TRacking Effects of Environmental organic micro-pollutants in the Subsurface) aims to develop an innovative technological platform for monitoring MPs based on the assessment of their biologicaleffects. The proposed setup will be composed of the following steps: (a) Extraction and pre-concentration of MPs and their possible transformation products in soil or water samples by solid phase extraction. (b) Separation of the extracts using high performance thin layer chromatography (HPTLC). (c) Biological effect measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) bioreporters. A main goal of our study is to develop tools and methods for a multiparameter effect detection covering a range of potentially adverse biological effects. This can be achieved by the construction of yeast strains using specific fluorescence reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC with a different high performance liquid chromatography (UV) system and gas chromatography (GC) or a different high throughput liquid chromatography (LC) system with a UV detector and a mass spectrometer (MS) will be performed. Next steps will include (i) the analysis of real samples, (ii) the further development of additional sensor-strains like other yeast for the detection of toxicological effects and (iii) method development for the detection of compounds by chemical analysis after separation by HPTLC. 4b clear="all" ] [1] A German-Israeli research and development project in the field of water technology within the framework of the BMBF-MOST cooperation, FKZ: 02W11387.

TH062 Endocrine disruptors used in polymers in the offshore oil and gas industry

C. Phillips, Cefas Lowestoft Laboratory / Science Directorate - advice and assessment; R. Suehring, University of Toronto; A. Smith, Cefas / Ecotoxicology and Molecular Ecology

Concentrations were raised by regulatory assessors that a number of polymer substances found in products registered for use and discharged offshore as a result of the activities of the oil and gas industry are based on monomers that are known and suspected endocrine disruptors. These polymers were described by the registration data as being moderately or readily biodegradable substances and might therefore have the potential to biodegrade into the endocrine disruptors on which they were based. We wish to understand how these technologies contribute to the biodegradation of hydrocarbons and how the hydrocarbons affect the biodegradation of the endocrine disruptors. To determine the potential of these polymers to release endocrine disruptors, four substances with known endocrine disrupting monomer groups were extracted using high pressure and temperature as well as acidification and/or biodegradation and were tested using a Yeast-based estrogen screen (YES) and yeast-based androgen screen (YAS). The results from the presented study show that at least one of the analysed products has a high potential for releasing EDs and highlights the importance of well-informed environmental protection to prevent endocrine disruptors from impacting the marine environment.
Thyroid disruption screening using zebrafish as vertebrate model

L. Iurria, O. Jaka, C. Martí, A. Alzuale, BioBide; A. Muriana, BBD BioPhenix S.L. / RD

Endocrine disrupting compounds are frequently found in the environment and have a profound impact on the development and physiology of vertebrate organisms.

Thyroid Disrupting Compounds (TDC) specifically affects the function of thyroid hormones, interfering with their synthesis, transport and/or binding, altering important physiological processes. Several environmental contaminants such as polychlorinated dibenzo-p-dioxins and dioxin-like compounds, used as plasticizer and flame retardant, are suspected to produce a thyroid-disrupting effect. Given so, chemical manufacturing entities could benefit from cost-effective methodologies for the screening of TDC in order to deselect candidates during the early phase of the development. In this work, we present an assay for the screening of potential TDC using zebrafish embryo. This vertebrate model is extensively used as a biosensor for the evaluation of acute and developmental toxicity, and several assays in zebrafish are described by the OECD guidelines for the testing of chemicals. Besides, the embryo’s small size and transparency allow to carry out fluorescence-based screening assays with medium throughput. In this work, the thyroid hormone disruption potential of several environmentally relevant contaminant was assessed. For this end, an initial acute toxicity assay was performed in order to estimate the EC50 and NOEC of the tested compounds, and subsequently select concentrations with no systemic toxicity. Afterward, change in the thyroglobulin (TG) synthesis was assessed using a zebrafish transgenic line expressing a mCherry fluorescent protein under the control of the zebrafish thyroglobulin (TG) gene promoter, by analysis of the fluorescence microscopy images. Finally, a gene expression assay, using rt-qPCR, was performed over known markers of thyroid disruption to further characterize the involved pathways of endocrine disrupting effect. The zebrafish assay showed to be a sensitive and cost-effective assay to evaluate the potential thyroid disruptor activity of chemicals.

Development of stably transfected cell lines with zebrafish thyroid hormone receptors alpha and beta for assessing endocrine disruption in environmental samples

Y. Vélez Herrera, INIA National Institute for Agricultural and Food Research and Technology; E. Sánchez Martínez, Instituto de Aquacultura Torre de la Sal-Spanish National Research Council; M. Fernandez-Cruz, J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment; J. Cerdà Reverter, Instituto de Aquacultura Torre de la Sal-Spanish National Research Council

Endocrine-disrupting chemicals (EDCs) are ubiquitous in our environment and can be found in many products including food/feed, containers as plastic bottles or metal food cans, cosmetics, pesticides, flame retardants, detergents… Accordingly, they suppose a threat to animal and human health through different exposure routes. In vitro bioassays are valuable tools for detecting and studying EDCs action and provide a sensitive and rapid system to evaluate their potential effects. In addition, the development of cell lines that express thyroid hormone receptors (TRs) and TRβ1-pcDNA3 constructs, together with luciferase gene (DR4-TK-Luc reporter construct) under the control of thyroid hormone response elements (TRE), Forty-eight hours post-transfection, cells were harvested and seeded in 96-well plates in Dulbecco’s Modified Eagle’s Medium (DMEM) supplemented with 0.4 mg/ml G-418, 10% fetal bovine serum and 1% penicillin/streptomycin (selection medium). To test the stable integration as well as the expression level of the receptor positive clones were plated in 96-well plates and exposed to a range (from 1 μM to 1 mM) of triodothyronine (T3) concentrations. Finally, the clones showing better EC50 values were selected to determine the presence of thyroidal activity in livestock residues including agricultural admixtures. These transactivation systems allowed distinguishing the contribution of each TR to the residue-induced thyroidal activity. Acknowledgments - Supported by RTA2012-00053-00-00, RTA2015-00041-00-00 and AGL2016-74857-C3-R.

Screening endocrine disrupting potentials of alternative plasticizers using thyroid hormone receptors

G. Lee, H. Kang, Seoul National University Graduate School of Public Health; K. Choi, Seoul National University / Environmental Health Sciences

Plasticizers have been used as plasticizer in polyvinyl chloride (PVC), food containers, medical devices, building materials, and personal care products. Because of reproductive toxicity of several plasticizers including bis(2-ethylhexyl) phthalate (DEHP) and diethyl phthalate (DEP), use of major phthalates are regulated in many products in several countries. Accordingly, many alternative plasticizers have been developed and increasingly used worldwide, but their possible adverse endocrine disruption effects are not well-known. The aim of this study is to screen endocrine disrupting potentials of several widely used alternative plasticizer, cyclohexane dicarboxylic acids (DINCH), acetyl tributyl citrate (ATBC), dioctyl terephthalate (DOTP), trioctyl trimellitate (TOTM), bis(2-ethylhexyl) adipate, and diethylhexyl adipate (DEHA). A series of in vitro assays employing a human breast (MVLN), a human adrenal (H295R), and a rat pituitary (GH3) cells, were employed. The test doses for each plasticizer applied were determined based on preliminary cytotoxicity assays for each cell line. While not all alternative plasticizers showed significant activity, their affinity in MVLN cells. DINCH and DEHA exhibited significant increase in estradiol (E2) to testosterone (T) ratio in H295R cells. These results suggest that these plasticizers DINCH and DEHA cause increased estrogeneity through altering steroidogenic pathway, similar to DEHP. In GH3 cell line, ibh1 gene was significantly downregulated by exposure to TOTM, suggesting its thyroid disrupting potential through altering signaling pathway to thyroid gland. Our observation shows that DINCH, DEHA and TOTM may disrupt balance of important hormones. Further investigations using in vivo models are warranted.

Development of reporter gene system for assessing cherry shrimp ecdysone receptor agonists using mammalian cells

K. Chan, The Chinese University of Hong Kong / Life Sciences; Y. Chan, K. Chu, The Chinese University of Hong Kong / School of Life Science

Ecdysteroid is a key steroid hormone that regulates growth, development and molting in animals under the phylum of Arthropod, which includes the insects and crustaceans. The hormone targets the receptor component which recognizes the ecdysone receptor (EcR) and retinoid X receptor (RXR). The activated complex anchoring on the ecdysone responsive element (EcRE) stated on the promoter subsequently initiates transcription of the responsive gene(s). Chemicals act as receptor agonists do not necessarily adopt the structure of the native hormone, as in the case of estrogenic endocrine disruptors. Recently, for insect pest control, synthetic diacylhydrazine (DAH) and bisphenol A (BPA) were developed to disrupt ecdysone/receptor signalling. They work as ecdysone receptor agonists, which cause premature launching of the molting process and subsequently death. Crustaceans, as a subphyllum closely related to insects phylogenetically, also adopt this ecdysone signalling system, as they share the hormone, hormone synthetizes enzymes and the receptors. Thus, these endocrine disrupting insecticides, together with other untested potential endocrine disruptors, may pose a threat on the crustaceans. Here we report the development of an in vitro reporter assay for the screening of ecdysone receptor agonist in cherry shrimp. The assay is done by transiently transfecting mammalian cells with plasmid vectors expressing cherry shrimp EcR and RXR, together with a vector carrying a luciferase reporter gene fused to a minimal promoter linked to five copies of EcRE. The results show that the system responds well to the native ecdysone hormones in a dosage-dependent manner. The adaptation of mammalian cells in vitro assay for heterogenous receptor is satisfactory. Three DAH/BAH insecticides were also tested and gave minimal to moderate signals. The results suggest that these DAH insecticides aimed for insect pest control can be potential hazards to crustaceans. More studies on different mammalian cells and competition study with mixtures of chemicals are being carried out to validate this reporter gene system.

Micro-injection as an alternative for aquatic exposure? A case study in zebrafish embryos with 17a-ethynylestradiol.

E. Michiels, University of Antwerp / Zebrafishlab Dept Veterinary Sciences; F. Lai, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; L. Vergauwen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences SPHERE; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; A.L. van Nuijs, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; S.J. Van Cruchten, University of Antwerp / Applied Veterinary Morphology, Dep Veterinary Sciences; D. Knapen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences

Pharmaceutical companies have to perform an environmental risk assessment for every drug that is launched to the market. The mandatory tests for potential endocrine disrupting (ED) compounds are mainly performed in aquatic toxicity tests. However, it is often difficult to expose fish to poorly water-soluble EDs by the oral route. This work demonstrates that micro-injection in the yolk is therefore proposed as an alternative and ecologically relevant exposure route because the yolk of zebrafish embryos contains many lipids, and this route mimics maternal transfer. To be used as an exposure method, micro-injection needs to be characterized and compared to the traditional exposure route via water. In this study, 17a-ethynylestradiol (EE2, an estrogen receptor (ER) agonist) was chosen as a model compound to compare both exposure routes. Zebrafish embryos were exposed either via water or via injection within the first two hours post fertilization (hpf) until 120 hpf. Different endpoints at different levels of biological organization were assessed. Morphological (i.e., different types of abnormalities) and physiological (e.g., heart rate and swimming performance) endpoints were scored, as well as ER binding and qPCR analysis of 14 genes. An LC-MS/MS method was optimized for measuring EE2 levels in medium of the aquatic exposure experiment and the internal dose in embryos after aquatic exposure or injection. The pattern of brain aromatase mRNA expression
was different between both exposure routes, while vitellogenin (vtg) and estrogen receptor 1 mRNA levels were similar between both routes after EE2 exposure. At the morphological and physiological level we observed differences as well. However, the degree of ER-binding was similar between both routes from day 1 until day 5. Despite daily refreshment, the EE2 concentration in the medium decreased regardless of the exposure concentration. The internal doses were the highest at the beginning of the exposure for both exposure routes and decreased afterwards. The order of magnitude of the internal dose was also similar between the injection and an aquatic exposure in the μg/L-range, which was also seen e.g. for the mRNA expression of vtg1. Based on the dose measurements we can conclude that even if the embryos were dosed with EE2 within the same order of magnitude that there were still different outcomes for some endpoints. Therefore micro-injection is rather a complementary method and not an alternative route for aquatic exposure.

TH068
Vitellogenin expression, ovarian growth and hormone levels are affected by atrazine in the crayfish Procambarus clarkii


Atrazine, a widely used herbicide, has been categorized as a suspected endocrine disruptor for many years. Although several studies have investigated the effects of atrazine exposure on reproductive function, its safety remains controversial and the mechanisms of its toxicity remain unclear. In this study, we tested the hypothesis that atrazine can affect reproduction in crayfish through dysregulation of vitellogenin expression and hormone synthesis. Adult female crayfish (Procambarus clarkii) were exposed during one month to atrazine at concentrations of 1 or 5 mg/L. At the end of the exposure, ovaries, hepatopancreas and hemolymph samples were harvested for analysis of vitellogenin expression and steroid hormone levels.

Ovarian tissue was also sampled for both biochemical and histological analyses. Atrazine-exposed crayfish had a lower expression of vitellogenin in the ovary and hepatopancreas, as well as smaller oocytes and reduced vitellogenin content in the ovary. Despite these effects, circulating levels of estradiol increased in females exposed to 5 mg/L of atrazine, showing that the inhibiting effect of atrazine on vitellogenin production was not related to a lower secretion of sexual steroids; instead, some early stimulating effects of estradiol on vitellogenesis could have occurred. Moreover, ovarian tissue was also sampled for both biochemical and histological analyses.

TH069
Identification of molt-inhibiting hormone and ecdysteroid receptor sequences in Gammarus pulex and consequences of endocrine disruptor exposures

E. Gismondi, University of Liege

Endocrine disruptors (EDCs) are well known to disrupt the development and the reproduction of exposed organisms. Although this point has been studied in vertebrate models, the limited knowledge of the endocrine system of invertebrates makes the evaluation of EDCs effects difficult. However, invertebrates represent the first line of defense of the ecosystem, organisms, such as gammarids, which are crucial for their functioning (e.g. litter degradation, food resource). Moreover, gammarids are hosts of hidden parasites such as vertically-transmitted microsporidia (microsporidia VT), which could be confounding factors in assessment of EDC effects, since microsporidia VT could feminize juvenile males in some Gammarus sp. Consequently, currently, no biomarkers (assessment tools) are available to assess the effect of endocrine disruption in gammarids. The present work focused on EDC effects on the molt process of Gammarus pulex, by researching the DNA sequences of two main proteins in the endocrine system of amphipods: the molt-inhibiting hormone (MIH) and the ecdysteroid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-PCR in both MIH expression, whatever the parasitic status. However, a trend to increase was observed, than the mRNA expression of MIH was different between both exposure routes, while vitellogenin (vtg) and estrogen receptor 1 mRNA levels were similar between both routes after EE2 exposure. At the morphological and physiological level we observed differences as well. However, the degree of ER-binding was similar between both routes from day 1 until day 5. Despite daily refreshment, the EE2 concentration in the medium decreased regardless of the exposure concentration. The internal doses were the highest at the beginning of the exposure for both exposure routes and decreased afterwards. The order of magnitude of the internal dose was also similar between the injection and an aquatic exposure in the μg/L-range, which was also seen e.g. for the mRNA expression of vtg1. Based on the dose measurements we can conclude that even if the embryos were dosed with EE2 within the same order of magnitude that there were still different outcomes for some endpoints. Therefore micro-injection is rather a complementary method and not an alternative route for aquatic exposure.

TH070
Use of in vivo and in vitro assays to investigate the effects and bioavailability of endocrine disrupting compounds in sediment on the benthic invertebrate Chironomus riparius

S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; V. Esser, RWTH Aachen University / Physical Geography and Geocology; A. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shuliakevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; H. Hollert, RWTH Aachen University / Institute for Environmental Research.

Sediments act as a sink and source of chemicals in the environment and, therefore, it is of great importance to know how sediment-bound chemicals affect aquatic organisms. The synthetic hormone 17a-Ethinylestradiol (EE2), a component of oral contraceptives, is ubiquitous in the environment and is a known potent endocrine disrupting compound (EDC) that adversely affects aquatic vertebrates (e.g. reproduction development of fish) and invertebrates (e.g. endocrine risk on benthic organisms). The uptake and release kinetics of EE2 in the freshwater benthic invertebrate, Chironomus riparius, in a long-term sediment-water toxicity test using formulated EE2-spiked sediment and field sediment. Field sediments were collected from the Rivers Luppe (silt loam, 8% organic carbon; eastern Germany), Wurm and Inde (sand, 2% organic carbon; western Germany) as these rivers are heavily influenced by anthropogenic activities (i.e., downstream of wastewater treatment plants) and are suspected or known to contain high concentrations of EDCs. Two types of sediment were formulated with silicone sand, kaolin clay and peat moss to match the sediment types of the Luppe and Wurm/Inde. Each formulated sediment was used in the negative control, solvent control and spiked (10 μg EE2/g d.w.) treatments. The survival and growth of Ch. riparius were measured after 10-d in half of the replicates (n = 6), while the number of adults emerged, time to emergence and sex ratio were evaluated at the end of the 28-d test (n = 6). Extracts of the whole-organism were analyzed through a yeast estrogen receptor (YES) assay, a common in-vitro assay used to estimate estrogenic potential. Additionally, EE2 tissue extracts were quantified through LC/MS-MS with deuterated internal standards which were used to account for any losses during the extraction process. The bioavailability of EE2, inferred through the YES assay and LC/MS-MS analysis, provides insight into the bioaccumulation of EE2 in C. riparius larvae. Knowledge about the bioavailability, bioaccumulation, and estrogenic activity of EE2 on benthic organisms is important for understanding the potential effects on vertebrate predators and subsequent upper trophic levels as a secondary source of contamination.

TH071
Assessing acute toxicity of Bisphenol A on Daphnia magna by passive dosing approach

H. Kwon, Y. Jeong, H. Jeon, S. Kim, KIST Europe / Environmental Safety Group

Bisphenol A (BPA) is a raw material for widely used polycarbonate plastics, but it is known to have negative effects on human health and the environment. It was classified as an endocrine disrupting chemical (EDC), which requires an accurate and reliable toxicity data for robust risk assessment. However, currently available toxicity data (48h-E<sub>50</sub>) on Daphnia magna showed a significant discrepancy of 3.9-16.0 mg/L. Therefore, our aim is to determine the reliable toxicity of daphnia to BPA. Passive dosing as well as the existing toxicity testing protocol (i.e., spiking with co-solvent) were used to administer BPA to daphnia. Conventional spiking method often fails to control the exposure concentration of (semi-)hydrophobic organic compounds due to the loss of target compounds from sorption to the test vessel and volatilization. Here, passive dosing technique compensates for the concentration loss by using a biocompatible polymer as a reservoir. Moreover, the adverse effect of the only target compound can be considered in this format as passive dosing does not require a co-solvent to dissolve and deliver the target compound. BPA was used as a model chemical and a silicone O-ring was chosen as a reservoir for dosing BPA to Daphnia magna. The uptake and release kinetics of BPA on the O-ring were investigated until equilibrium. After the concentration of BPA in the test vessel reached equilibrium, we put Daphnia magna (< 24h) in it and checked the sub-lethal effect in 48h by following the OECD guideline 202. At the same time, the acute toxicity test by spiking BPA dissolved in methanol (0.01%) was conducted with the same range of BPA concentrations (0-10 mg/L). Through the passive-dosing method, we were able to determine the silicone-water partition coefficient of BPA and control stable concentration over the test period. The uniform concentration of BPA induced the half maximal effective concentration of daphnids at the lower concentration. We expect that the application of this method in a chronic toxicity test will provide more reliable environmental hazard and risk assessment of BPA. Furthermore, this result suggests that passive dosing could be adjusted to less hydrophobic compounds like BPA (log K<sub>ow</sub> of 3.64).
Toxic effects of juvenile hormone analogue insecticides, methoprene and fenoxycarb, on cherry shrimp (Neocaridina davidi)

X. HU, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences; K. Chu, The Chinese University of Hong Kong / School of Life Sciences

Crustaceans are a large group of arthropods, and they are the major constituents to aquatic ecosystems that provide a variety of ecological and economic services. Nevertheless, the increasing quantities of insecticides leached into water bodies severely affect the health of aquatic environment globally and heighten the adverse impact on the crustaceans. Among these insecticides, juvenile hormone analogue (JHA) insecticides are a kind of endocrine disruptors known to interfere with the normal hormone action in insects by mimicking the juvenile hormones. However, the structure and functions of the methyl farnesoate (MF) in crustaceans are similar to the juvenile hormone (JH) in insects. Therefore, the exogenous JHA insecticides would cause adverse effects on the development and reproduction in crustaceans as in insects. The aim of our study is to examine the toxic effects of JHA insecticides - methoprene and fenoxycarb on a freshwater shrimp Neocaridina davidi which is successfully cultivated and maintained in our laboratory as a new crustacean model. These insecticides are growing in use in agriculture both locally and globally, and their impact to the aquatic ecosystem is needed to be further clarified. In the present study, the acute and chronic toxicity effects of two juvenile hormone analogue insecticides, fenoxycarb and methoprene, on newborn N. davidi were investigated. The 24h and 48h median lethal concentrations (LC50) for fenoxycarb and methoprene were 1.40, 0.97 mg/L (4.64, 3.30 mmol/L) and 1.96, 1.26 mg/L (6.32, 4.06 mmol/L) respectively. The toxic effects of fenoxycarb and methoprene on shrimp development are described in the study. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH075 Diet and non-dietary prenatal exposure to endocrine disruptors (BPA and DEHP). Spanish case study.

M. MAR, INDÉZ RODRÍGUEZ, J. Rovira, Universitat Rovira i Virgili; R.P. Sharma, Universitat Rovira i Virgili / Departament d Enginyeria Química; M. Nadal, Universitat Rovira i Virgili / School of Medicine, ISPVP; V. Kumar, Universitat Rovira i Virgili / Departament d Enginyeria Química; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Química

Endocrine disruptors (EDs) are chemicals that can interfere with the action of hormones and can cause adverse effects on human health. The present study assesses the cytotoxicity and ability to disrupt aromatase activity of organic PM extracts from rural and urban areas at different collection tubes were used for the clotting process resulting in different LLOQs of 5 pg/mL for T3 (final range 5 to 1500 pg/mL), and a final range of 70 to 70000 pg/mL for T4 was developed and validated using LC-MS/MS (liquid chromatography coupled to tandem mass spectrometry detector). The method validated utilizes a 50 μL sample volume of serum to determine both T3 and T4 from the same sample aliquot. Across several studies from various Toxicology facilities a detailed picture was observed of the various levels particularly prevalent in fetuses and Day 4 of age pups. Considering that samples are collected from animals of fetuses and Day 4 of age pups, which may be triggered for analysis subsequent to Day 3 and adult male samples being analyzed, the emphasis of the integrity of the sample is paramount to...
ensure meaningful data can be collected. An experiment was performed to evaluate if tubes containing clot activator could produce 'cleaner' serum samples to avoid loss of data points from analytical instrument signal suppression, yet provide true and accurate data without significant loss of T3 and T4 arising from potential absorption or non-specific binding to the clot activator tube. The CV (precision) and RE (accuracy) for both T3 and T4, across quality control samples (generated from collection tubes (a) and (b)) were within acceptance criteria of ≤20% (25% for the LLOQ) demonstrating that tubes containing clot activator can be used for T3 and T4 sampling.

TH077
Steroid estrogens and estrogenicity activity in abattoir wastewater from dairy farm watersheds regardless of effluent management practices
L. A. Tremblay, Cawthron Institute; J. B. Gadd, NIWA / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited
Steroid estrogens contamination has been linked to adverse effects on aquatic biota. Steroid estrogens are excreted by all mammals and are therefore found in most agricultural wastes including dairy manure and dairy shed effluent (DSE). Some previous studies have demonstrated elevated levels of free and conjugated estrogenic steroids in DSE and this source has increased as New Zealand has experienced rapid expansion and intensification of dairy farming. This research used an approach incorporating analytical chemistry and bioassays to evaluate the levels of estrogenic activity in environmental samples from representative dairy watersheds with differing DSE management practices: either isolated from dairy farm inputs or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more information and effective management.

TH078
Toxic receipt: Why You Should Avoid it?
J. Mila, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randjelovic, L. Šojić, ALHem - Safer Chemicals Alternative
Bisphenol A (BPA) is at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine system and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estrone was the predominant steroid measured in watershed waters because of its presence in dairy cow wastes and as a degrade of the main dairy cow estrogen, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalent E2eq) was found in low levels in 85% of thermal samples (highest 1.44 ng L⁻¹ EF = 5% of the ground samples (≤0.15 ng L⁻¹ EF). While estrogenic activity was generally -1. one of (10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L⁻¹, a level potentially harmful to aquatic biota. Comparable steroid concentrations and estrogenic activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

TH080
Evaluate the ecological risk during product development: safe by design case study - Met@link project
R. Sadnicka, VITO / ABN VOG; Je. V. Radek, VITO NV / Health; s. verstaeten, VITO / OBS
Safe by-design requires risk evaluation at critical points during the development of a product to enable a well documented choice for the lowest risk option. In the Met@link project new metal-based inks - enriched with Ag-nanoparticles (Ag-NP) - for printing conductive tags are developed. The environmental risk is assessed to support decisions between different environmental risk options (or risk management options). Estrogenic activity (REA) was assessed (using the E2eq risk assessment of the potential effects on the one hand (concentration effect relations for the target organisms) and evaluates the potential exposure of target organisms on the other hand (i.e. to define the environmental compartments and organisms of concern). Risk management either reduces the potential effects (i.e. redesigning the product) or prevents the predicted exposure (i.e. redesign the production process) to minimize the potential risk. Case study: ERA Ag-NP metal based ink. Potential exposure of concerned aquatic ecosystems, mainly due to the leaching of Ag+ ions. Potential exposure? Looking at the production process the aquatic ecosystem is of concern because of the waste water generated during production of the inks. Two prototype inks with suitable technical properties were formulated. Both were tested for their leaching potential and for their ecotoxicity to aquatic organisms. Ag-concentrations (ICP-AES) and Ag-NP (SP-ICP-MS) were measured, and the ecological effects on algae (OECD 201) and Daphnia (OECD 202) were measured. Results showed that proper coating material helped to prevent leaching of Ag+ and substantially decreased the ecotoxicity of the leaching fraction.

TH081
REACH Substance Evaluation of silver - justification of read-across from ionic silver to nanosilver
K. Arijis, ARCHE; J. Mertens, Precious Metals and Rheinum Consortium c/o EPMF
As part of the REACH Substance Evaluation for silver, new data was required to be generated. We further justify the read-across from ionic silver to nanosilver. Information on aquatic and soil ecotoxicity of the smallest silver nanopowder with the highest specific surface area registered under REACH as compared to ionic silver. The tested nanopowder shall be sufficiently characterised; Information on the fate of nanosilver in soil only in case any of the ecotoxicity tests show higher toxicity for nanosilver as compared to ionic silver. Information on the uses for each individual nanopowder registered under REACH. In the ecotoxicity testing programme was therefore undertaken comparing the effects of nanosilver with silver nitrate using 3 internationally standardised and accepted aquatic ecotoxicity tests: Toxicity to the algal Pseudokirchneriella subcapitata (OECD Test Guideline No. 201); nanosilver was less toxic than silver nitrate. Long-term toxicity to Daphnia magna (OECD Test Guideline No. 202) for silver nanoforms; Information to soil microorganisms (OECD Test Guideline No. 216) in 3 soils representative for the EU: nanosilver was equally or less toxic than silver nitrate. The silver nanopowder was fully characterised (aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape, mean primary particle size 9.4 nm). The dissolution behaviour of the tested silver nanopowder was determined in the test media used in the ecotoxicity tests. The nanosilver dissolution behaviour qualitatively explained the observed toxicity. Since the ecotoxicity testing demonstrated that nanosilver was equally or less toxic than ionic silver, further fate testing in soil was not required. The data collection on the uses of the silver nanoflours covered by the REACH registration dossier showed limited tonnage and use of nanosilver. Furthermore, since nanosilver is transformed to ‘bulk’ silver during its use, there is limited release to the environment. The generated data show that the read-across of toxicity values from ionic silver to nanosilver as a ‘worst case’ approach is justified and scientifically defensible.

TH082
Revising REACH technical guidance on information requirements and chemical safety assessment for engineered nanomaterials for aquatic ecotoxicity endpoints - recommendations from the EnvNano project
S. F. Hansen, Technical University of Denmark / DTU Environment; S. N. Sorensen, DTU Environment / DTU Environment; L. Skjolding, DTU / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Borell, Technical / DTU Environment; G. Met@link project
The European Chemical Agency (ECHA) is in the process of revising its guidance documents on how to address the challenges of ecotoxicological testing of nanomaterials. In these revisions, outset is taken in the hypothesis that ecotoxicological test methods, developed for soluble chemicals, can be made applicable to nanomaterials. European Research Council project EnvNano - Environmental Effects and Risk Evaluation of Engineered, which ran from 2011-2016, took another outset by assuming that: “The behaviour of nanoparticles...
Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental potential in our project. It is about the development of a risk assessment procedure that is based on the behavior of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (factor 1 to 3) for each so called “fate bond” which will be included in a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in the considered compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not needed to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate information is based on (fate bond) is concerned with the most ecotoxicological hazard properties (ecotox bond; present at an additional postier) of an ENM. In this poster, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: transformation, transport, fate grouping Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no.: 03X0002.
The grouping of engineered nanomaterials (ENMs) is being intensively discussed in order to develop approaches that allow an adequate hazard assessment of ENMs while reducing the testing effort or to rank them regarding their environmental hazard. Two approaches differing in their focus have been developed and evaluated with a set of 25 ENMs. Based on systematic testing using aquatic test designs used in regulatory testing, the physical-chemical (PC) properties, intrinsic material properties and morphology were characterized as well as ecotoxicology and the chemical were identified as relevant parameters. The zeta-potential was considered to be less important. Regarding the parameters ecotoxicity of the bulk chemical, solubility and reactivity we decided upon a pragmatic approach with questions which have to be answered “yes” or “no”. Approach I (ecotox flow-chart) is characterized by maximum 24 growth compartments. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotox-bond every “yes” for an answer gives one point. The points are added together resulting in five groups in a range of 1 to 5 which is used for further assessment. The same number of points can be achieved by different properties resulting in groups of ENMs which can differ significantly in their PC-properties. This procedure is considered suitable for the initial prediction of discards. It is more important that the groups that have been subjected to environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.

**TH087**
Forms of released engineered nanomaterials: A systematic assessment in material flow analysis

V. Adam, EMPA Technology & Society Lab / Technology and Society Lab; A. Cabaliero-Guzman, EMPA / Technology and Society Lab; B. Nowack, Empa Swiss Federal Laboratories for Materials Science and Technology / Technology and Society Lab

The forms in which engineered nanomaterials (ENMs) are released to the environment affect their fate and toxicity, two parameters essential to risk assessment. Yet, most of current models assessing ENM releases to the environment do not fully account for the transformations that they undergo before release to the environment. This work consists in the development of a method based on current literature, expert elicitation and probabilistic material flow analysis (PMFA) for modelling the proportions of nano-Ag and nano-TiO₂ flowing in dissolved, transformed (particles that have been subjected to chemical transformations), matrix-embedded (ENM released while embedded in a solid matrix), nanoparticulate (non-transformed, not embedded ENM including free, aggregated and agglomerated ENMs) and product-embedded (ENM contained within a whole product, going to solid waste treatment) forms to the environment. Transformations of ENMs in the environment are excluded from the scope of this work. Our model includes 10 main steps and 32 compartments. The ENMs flow from production, manufacturing and use to wastewater treatment (sewer system, wastewater treatment plant and sludge) and solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variability of the data obtained in the literature was used to assess the width of the distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-TiO₂ presents contrasting results, as most of the releases to air, soil and water are in nanoparticulate forms (80%; 94% and 99%, respectively). The only transformation identified is the occurrence of the mineralization of organic forms of ENMs which are released constitutes an essential piece of information for the input data to environmental fate modelling. For the first time, a method was developed for a systematic assessment of these released ENM forms. Results show that, especially for nano-Ag, the actual nanoparticulate form represents only a small fraction of the total ENM mass released to the environment, thereby calling for a revision of current exposure levels commonly used.

**TH088**
Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials

J.T. Quik, RIVM / DMG; J.A. Meester, E.A. Bleeker, J. Slootweg, RIVM / VSP; S. Lofts, NERC Centre for Ecology & Hydrology / Shore Section; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox® modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox model was recently extended for use with nanomaterials (SimpleBox4.0-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution. In this study we show the sensitivity of SimpleBox4.0-nano to the newly added process parameters. This shows that in addition to the dissolution rate, reactivity and attachment efficiency, also the concentration of natural particles and their size play a role. In order to use SimpleBox4.0-nano we provide guidance on measuring or calculating the relevant input parameters. Furthermore, we indicate the relevance of the different fractions of PECs as calculated by SimpleBox4nano for estimating the risk quotient. 1: www.rivm.nl/simplebox; 2: Meesters, J.A.J., et al., Multimedia Modeling of Engineered Nanoparticles with SimpleBox4nano: Model Definition and Evaluation, Environmental Science & Technology, 2014. 48(10): p. 5726-5736.

**TH089**
Directions of in silico method development to complement the predictive models used in risk assessment of nanomaterials

J.T. Quik, RIVM / DMG; M. Bakker, RIVM / VSP; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; M. Poikkinimaki, M. Dal Maso, Tampere University of Technology / Aerosol Physics; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

There is an increasing need for predictive risk assessment of nanomaterials (NM) that are not yet covered by regulatory approaches. This is especially true for non-aggregated NM. In order to allow for risk assessment of NM, it is necessary to develop new methods that serve as suitable starting points for further development of in silico methods. We analyze these needs and propose further development of in silico methods for predictive risk assessment of NM. In particular, the use of descriptors related to the interaction between a NM and its surroundings, e.g. the attachment efficiency, is proposed. QSARs as well as other in silico methods are well suited to fill this gap in predictive risk assessment, under the condition that enough data of reliable quality becomes available.

**TH090**
NanoScreen - Minimizing the risk associated with nanomaterials used in sunscreen at all lifecycle stages

R. Catalano, Aix-Marseille Université; J. Labille, CNRS; D. Slomberg, Aix-Marseille Université; O. Radakovitch, IRSN; M. Zerrad, Institut Fresnel - Aix Marseilles Université; S. Rokac, CENA / ENSEG DRECAM

Among cosmetics and personal care products, sunscreen products are of emerging concern regarding both environmental and human health. While some organic UV blockers have been evidenced to undergo rapid photodegradation, to induce allergenic skin reactions due to dermal penetration, or to cause deleterious effects on marine system, the fate of mineral UV blockers is still under consideration from a regulatory perspective. This is largely related to the potential impact of nanotechnology-based products on both environment and human health. The nano-TiO₂ UV-blockers typically used in sunscreen usually consist of rutile nanoparticles coated with a first mineral layer of silica or alumina aimed at blocking the photocatalytic character, and thus passivating the nanomaterial. In addition, the grafting of a second layer of organic coating is aimed at favoring the nanomaterial dispersion in the cream formulation. Once drained from the skin either through bathing activity or everyday usage and cleaning, the nanomaterials contained in the sunscreen can be released to the sea shore. Their behavior in this system is largely determined by this industrial coating and by their initial dispersion in the formulation. This project aims to develop the Eco-design of sunscreens through the implementation of the environmental SE, to cover the effects of environmental and social aspects associated with nanomaterials incorporated into the formulation. The fabrication and end of life steps are mainly considered and studied using the following two approaches. In order to estimate the release of nanomaterials from sunscreen in marine environment and the subsequent bioaccessibility to the living organism, we carried a field campaign on three beaches on the french coast. The titanium concentration was measured in the sea water as a function of the beach. The exposure of swimmers. It is fair to say that the higher nanoparticles concentration in the sunscreen, the higher the release factor. In order to decrease the nanoparticles concentration in the suncream without decreasing the sun protection factor, the filter selection and coating property is a key step. The filter coating determines its dispersion in the cream formulation, and thus the UV ray protection on the skin. In a laboratory approach we aimed to formulate the best filter-cream dispersion, in order to maximise the sun protection factor while maintaining low dose of nanoparticles.
A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel Corbicula fluminea


The identification and scientific assessment of compounds that bioaccumulate in organisms and biomagnify in food webs play a key role within the PBT-assessment. The bioaccumulation potential of compounds is commonly expressed in form of bioconcentration factors (BCF) determined in flow-through studies with fish according to OECD 305. Comparable studies with manufactured nanomaterials (MNMs) is difficult to carry out due to the lack of suitable test systems that allow a permanent and constant exposure of the compounds. MNMs tend to sediment in water and are supposed to be primarily taken up by benthic species in aquatic ecosystems. Different studies have shown that mussels are able to ingest and to incorporate MNMs suspended in water. However, existing standardised test methods to investigate the bioaccumulation of substances in mussels have been developed and optimized for soluble, non-particulate substances. Therefore, an alternative test concept was developed allowing to investigate the bioaccumulation of MNMs in both water and mussels under flow-through conditions. First studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMs (NM300K) and silver nitrate we were able to compare the accumulation and elimination of ionic and nanoparticulate silver. Mussels were exposed for a period of 4 - 6 days. In both cases steady state concentrations of total silver in the mussel tissue were reached within 24 hours. The quantification of the silver content was carried out by ICP-MS or ICP-OES. The measurement of ionic silver and water concentrations were used to determine bioaccumulation factors for both test items. In a further study the bioaccumulation of a titanium dioxide nanomaterial (NM 105) was tested. The studies have shown that the new test system is suitable to investigate the bioaccumulation of MNMs.
The global distribution of certain perfluoroalkyl and polyfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible toxic effects. There is a variety of PFASs and the film forming surfactant (AFFF) impacted sites may be contaminated by the relatively limited number of certified standards to ensure a rigorous quantification. A possible solution is the implementation of a surrogate approach such as the total oxidizable precursor (TOP) assay, relying on the oxidative conversion of potential perfluorooalkyl acid precursors (Pre-PFASs) to readily measurable products like carboxylic acids. However, in order to ensure a fully legitimate comparison between conventional (i.e., before oxidation) and after TOP analyses, a number of critical knowledge gaps remain to be bridged. The two types of water samples (i.e., before TOP versus after TOP) might reveal differential instrument matrix effects or necessitate different clean-up strategies, which could de facto impact the method reporting limits and preclude a consistent comparison between the two approaches. The present work aimed at assessing the applicability of the TOP assay to various water matrices through stringent validation. The performance of a workflow involving persulfate oxidation followed by ultrahigh performance liquid chromatography tandem mass spectrometry (TOP-UHPLC-MS/MS) analysis was therefore evaluated using various environmental waters. The validation endpoints ascertained included, notably, the evaluation of oxidation yields in the various matrices and TOP assay as a chemical assessment tool. In the environmental context, TOP-UHPLC-MS/MS is an advantageous method for the determination of PFASs in environmental media.

**TH096**

Use of biochars for the sorption of poly- and perfluorinated alkyl substances (PFAS) and heavy metals from contaminated soils

L. Silvan, Norwegian Geotechnical Institute; Y. Zhang, NMBU; G. Okkenhaug, A. Bottin Smbye, g. cornelsen, s.e. hale, Norwegian Geotechnical Institute

The contamination of soil with a mixture of compounds represents a worldwide environmental issue. Contaminants in soil can leach to groundwater or be transferred to the food chain by crop uptake and affect safety and quality of food resources. Of particular concern are heavy metals and perfluoroalkyl substances that may contaminate food products. The contamination of both organic and inorganic pollutants can be found. In the present study four soils with different types of pollution (poly- and perfluorinated alkyl substances (PFASs) and heavy metals) and two different total organic carbon contents (high and low), were used. PFASs are a class of compound characterised by hydrophobic, alkyated, fluorine-saturated carbon-chain with a hydrophilic head attached at a terminal position. PFASs are resistant to both chemical and biological degradation. In addition, their resistance to chemical, physical and biological degradation renders them persistent. Heavy metal contamination is often a problem in soils from shooting ranges and metals pose a hazard and risk for human health and the ecosystems. The soils used in this work are contaminated with As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se and Zn. Among the remediation techniques, sorption is the most common method for both organic and inorganic contaminants removal from soil. Biochar (BC) has a high adsorption potential for organic and inorganic contaminants and can be made at a low cost. Biochar is thus a promising and economic alternative to other carbonaceous materials, such as activated carbon, for this environmental application. In this study, three BCs were used as sorbents: a wood BC (wBC) made from wood chip waste (used for all the treated soils), an iron enriched BC (Fe-BC) (used for the metal contaminated soils) and an activated biochar (aBC) (used for the PFAS contaminated soils). Isotherm batch tests have been carried out using a water and soil mixture (L/S=10) to which BC was added at increasing doses (from 0 to 20%). The aim of this work is to investigate i) whether biochar can be used as a sorbent material for the treatment of industrial contaminated soil, ii) whether BC can sort PFASs in soils with both high and low TOC contents, iii) if iron enriched BC increases the sorption of metal as compared to non-enriched BC and iv) whether there is a correlation of BC properties (surface area, pores, surface property, etc.) with sorption.

**TH097**

14 PFASs to organic soil constituents - the effect of H+, Na+, Ca2+ and Al3+ ions

H.F. de Campos Pereira, Swedish University of Agricultural Science / Department of Soil and Environment; M. Ullberg, Swedish University of Agricultural Sciences / Department of Soil and Environment; D. Berggren Kleja, Swedish University of Agricultural Science; J. Gustafsson, Swedish University of Agricultural Sciences / Department of Soil and Environment; L. Ahrens, Swedish University of Agricultural Sciences SLU / Dept. of Aquatic Sciences and Assessment

Environmental risk assessment of perfluoroalkyl substances (PFASs) requires accurate prediction of their sorption in soils. The aim of this study was to investigate sorption of 14 PFASs, including perfluorocarboxylates (PFCAs), perfluorosulfonates (PFASs) and perfluorooctanesulfonamide (FOSA), to an organic soil horizon and the effect of solution pH and simulated soil organic matter (SOM) net charge as a function of pH and added concentrations of Al3+, Ca2+ and Na+. Generally, the organic C-normalized partitioning coefficients (KOC) were negatively correlated with 0.32 ±0.11 log units per 1 unit pH and the SOM bulk net negative charge (−1.41 ±0.40 log units per log 10 cmolc kg−1). The sorption increased with increasing perfluorocarbon chain length (hydrophobicity) for both PFCA and PFASs with 0.60 and 0.83 log units per CF moiety, respectively. Comparing the effect of the PFAS functional head group on sorption, affinity followed the order PFCA < PFAS < FOSA. Effects from cation competition were primarily observed for the C8-C13 PFASs and perfluorohexane sulfonate (PFHxS), and for these substances, the SOM bulk net charge was the better sorption predictor as compared to the pH value alone. However, for sorption of the most long-chained substances (i.e. the C6-C13 and C13 PFCA, PFOS and FOSA), cation effects were small and instead sorption was more strongly related to the pH value. This suggests that the most long-chained PFASs have a binding preference towards the highly condensed parts of the humin fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

**TH098**

Environmeental degradation rates for new PFAS via decarboxylation potential in water, in a MS-collision cell and alloxane

Y. Nishi, NILU - Norwegian Institute for Air Research

Straight-chain perfluorolipidic carboxylic acids, like PFOA, are extremely stable chemical compounds. In contrast, several other perfluorinated carboxylic acids are less stable and undergo decarboxylation - spontaneous degradation with loss of carbon dioxide. For instance, perfluorobenzoic acid decomposes slowly in aqueous solution, while perfluoropivalic acid loses CO2 fast at room temperature that its spontaneous decomposition is a synthetic method for nonfluorosubstane. There are indications that novel oxygen-containing analogs of PFOA are less stable towards decarboxylation. A typical detection method for PFCAs is based on the same decarboxylation process: SRM transition from [M-1] to [M-45]. A collision energy, required for such transition is a measure of intrinsic stability of a compound. Therefore, a comparison of decarboxylation rates for this transformation can be satisfactorily predicted by DFT calculations at standard RB3LYP/6-31+G(d,p) level. Decarboxylation rates in water for perfluorinated and structurally similar carboxylic acids also correlate well with MS and DFT-derived energies. Thus mass-spectral information and results of simple quantum-chemical modeling can be used as a measure of abiotic degradation potential for per- or perfluorinated acids in aquatic environment.

**TH099**

Perfluoroalkylated acids (PFAAs) in soil and invertebrates (Isopoda) near a fluorochemical plant in Flanders, Belgium

T. Groffen, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; M. Eens, University of Antwerp / Department of Biology; L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Perfluoroalkylated acids (PFAAs) have been produced for over five decades. Due to their hydrophobic and lipophilic character they are suitable for a wide range of applications. However, PFAAs may enter the environment, accumulate in wildlife and may cause detrimental effects. The widespread use of PFAAs has resulted in a global presence. Therefore the major global manufacturer, 3M, phased out the production of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in 2002. Nevertheless, these compounds are still detected in high concentrations in the environment and biota. Especially the fluorochemical plant has been characterized as a PFAA point of environmental contamination. In the present study we measured the concentration of 12 PFAAs (8 perfluoroalkyl carboxylic acids (PFCAs) and 4 perfluoralkyl sulfonic acids (PFSA)s) in soil and isopods collected at a fluorochemical plant in Antwerp, Belgium. In addition, samples from four other areas were collected, representing a gradient in distance from the pollution source. We tested for both correlations between soil properties (e.g. total organic carbon (TOC) and PFAA concentrations in soil, as well as correlations between PFAA concentrations in soil and invertebrates. In the soil, PFBA, PFOA and PFOA were the only compounds that were detected at all sites. Soil concentrations of all other compounds, with exception of PFDoA and PFBS, were < LOQ in all sites except for the plant site. Median concentrations of 606 ng/g ww for PFOS and 8 ng/g ww for PFOA were detected in soil at the plant site, which are high compared to what has been reported in previous studies conducted in the area. Furthermore, these concentrations decreased significantly with distance from the plant. However, concentrations did not differ between the three locations that were situated farthest away from the plant. No significant differences in TOC were
observed among the studied sites, but TOC was positively correlated with multiple PFASs, including PFOS and PFOA. This suggests that the presence of PFASs in waste water treatment plant effluents may contribute to the overall PFAS burden in the environment, and that further research is needed to better understand the role of these compounds in aquatic ecosystems.
Oceanography

Fluorotelomer alcohols (FTOHs) and other poly- and per-fluorinated alkyl substances (PFASs) are common and ubiquitous by-products of various industrial telemotorization processes. They can degrade into various perfluorinated carboxylic acids (PFCAs) including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), which are persistent organic contaminants of concern. This study assessed the use of polyethylene passive samplers as a sampling tool for volatile PFAS precursors coupled to their analysis via gas chromatography–mass spectrometry (GC/MS). Parallel active and passive sampling was performed in ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 g/m³), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{PE}, were determined. A deployment at a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{PW}, during the 3-week uptake experiments. Derived log K_{PW} values for 6, 8, 2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSA and EiFOSA, derived log K_{PW} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MeFOSA and EiFOSA.

TH105

Occurrence and Removal of perfluorooctyl and polyfluorooctyl substances (PFASs) in full-scale water and wastewater treatment plants

H. Pozzi, I. Mazzetti, E. Canali, F. Bowler, S. Valsecchi, National University of Singapore / Civil & Environmental Engineering

Perfluorooctyl and polyfluorooctyl substances (PFASs) comprise a group of compounds that are widely used in the markets for stain repellents, polishes, paints and coatings. In recent years, the occurrence of PFASs in the environment has been recognized as emerging environmental problem due to their persistence, bioaccumulability and possible adverse effects. Unlike most other persistent and bioaccumulative organic pollutants, PFASs are water soluble. Therefore, removal of PFASs by water treatment processes could be a challenge. The objective of this study was to evaluate the ability of different water treatment techniques to remove PFASs from water. In this study, three full-scale water treatment plants were investigated during a one-year monthly sampling for the removal of 31 PFASs, including 20 perfluorooctyl acids (PFAAs) and 11 PFAA precursors. The treatment processes include conventional activated sludge system (CAS) and membrane bioreactor (MBR) system in plant 1, sand filtration (SF) and microfiltration (MF) in plant 2, and microfiltration, reverse osmosis (RO) in plant 3. In total, 16 samples were taken from each of the three water treatment plants over the year 2016. TH104

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers

V. Kodes, D. Leonorzyćca, Czech Hydrometeorological Institute / Section of water quality; R. Grubic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenes

The objective of the Study was to compare PFOS and PFOA concentrations determined in biota within CHMI bioaccumulation monitoring program from years 2010 – 2016. Material and Methods A bioaccumulation monitoring of selected perfluorinated alcohols (PFHxS) and perfluorooctanoic acid (PFOA) was performed in three rivers in the Czech Republic. Monitoring comprises two profile sets consisting of 21 and 22 monitoring sites. Sampling at those two site sets alternates in the three-year cycles. Sites are located at important parts of main Czech rivers (country borders, before confluences, downstream industrial sites or large cities, etc.). An assessment was made for following matrices: juvenile fish, benthos (Hydropyche sp., Erophidua sp.), microalgae and plankton (mainly chlorophyll a). The analyses of fish were conducted for following tissues: muscle, blood and liver. In total, following number of samples of various matrices were analysed using LC-MS/MS and LC-HRMS: fish blood 105, fish liver 15, fish muscle 78, juvenile fish 149, benthic organisms 126, mussels 73. Results PFOS highest values were detected in fish blood (10 - 3030 μg/L), juvenile fish (1.2 - 312 μg/kg), and benthic organisms (0.05-0.06 61 μg/kg) 

TH107

Analytical strategy to study the distribution of perfluoralkyl substances in fish tissue of Italian deep subalpine lakes


Perfluoralkyl substances, such as perfluorinated sulfonic acids (PFSAs) and perfluorinated carboxylic acids (PFCAs), are ubiquitous contaminants in the aquatic environment, including wildlife and humans. Perfluorooctyl acids bind to proteins and the binding in bioaccumulation behaviour different from that of lipophilic substances. Therefore, conventional methods (fish fillet analysis, lipid normalization, etc.) to monitor their concentrations in aquatic biota cannot be used as such to assess the bioaccumulation and biomagnification of PFCA and PFSA. In this study, conventional monitoring approaches and new strategies are compared to assess the best methodology to be implemented in biota monitoring plans for these compounds. Several fish species were monitored in four Italian deep lakes. Selection of the most appropriate sampling and analytical strategy was assessed according to a pre-defined set of criteria (method precision, sample handling and storage, analytical scope). In order to better understand the seasonal patterns, sampling was performed over the whole year 2016. Material and Methods A bioaccumulation monitoring of selected PFASs was performed in ambient air in Providence (RI, USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 –16 g/m³), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{PE}, were determined. A deployment at a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{PW}, during the 3-week uptake experiments. Derived log K_{PW} values for 6, 8, 2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSA and EiFOSA, derived log K_{PW} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MeFOSA and EiFOSA.

TH108

Potential contribution of targeted and unknown precursors to the apparent biomagnification of perfluoralkyl acids (PFAA) in the food web of an urban river

C. Simonnet-Laprade, University of Bordeaux UMR EPOC; H. Budzinski, University of Bordeaux; K. Maciejewski, UMR EPOC; K. Le Menach, UMR CNRS EPOC Universite Bordeaux / UMR UMR 5805; R. Santip, University of Applied Sciences Western Switzerland; F. Alliot, A. Goutte, EPHE / UMR METIS; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC

This study assessed the potential contribution of targeted and unknown fluorotelomers (FTOAs) and perfluorooctyl substances (PFOAs) to biomagnification of perfluorinated substances in the trophic web of the urban river Orge (near Paris, France). A total of 16 PFAs and 10 of their precursors (pre-PFAs) were identified in fish muscle as expected. PFOS concentrations in fish blood, kidney and liver were higher than concentrations found in muscle tissues due to its binding to proteins in a blood and a liver. All collected fish blood samples and more than 50% of collected samples of fish liver and juvenile fish exceeded EQs for PFOA (9.1 μg/L).
precursors to the apparent biomagnification of PFCAAs, via their biotransformation. In addition, the Total Oxidisable Precursor (TOP) assay was applied to sediments and, for the first time, to biota samples. Results revealed the presence of large proportions of unknown pre-PFAs in sediments/biofilm/leaf litter samples (64-80% of total PFAS molar concentration); this proportion was lower in invertebrates (28-54%) and in fish (15-26%). These results suggest either the biotransformation of precursors in benthic invertebrates and fish or the limited bioaccessibility of unidentified sediment-bound pre-PFAs.

**TH109**

PFAS and their precursors in the Environment. First indications from a large scale environmental monitoring study


Per- and Polyfluorinated Substances (PFAS) have been an ongoing challenge for the environment sciences for decades. However, the substance versatility, in terms of chemical classes and physico-chemical characteristics yet hinders a full overview of the spectrum. Due to the differential mobility and degradation pathways, the environmental distribution of individual species is complex and requires massive analytical effort. This obscure situation is even stretched new from molecules from international markets, that already travel around the world in order to substitute or as ingredients of rainbow trout applications. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFAS), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFPA), and also precursors (e.g. PAPs, dIPAPs, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

**TH110**

A physiologically based toxicokinetic (PBTK) model describing the bioaccumulation of two perfluorinated substances in rainbow trout (Oncorhynchus mykiss)

A. Vidal, Istrea Lyon; R. Beaudouin, INERIS / Models for Ecotoxicology and Toxicology METO; E. Vulliet, CNRS / TRACES Team; E. Rochard, Istrea Bordeaux / UR EABX; J. Garric, Istrea Lyon / UR RIVERLY Laboratoire Ecotoxicologie; C. Vogs, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Environmental Medicine; M. Näslund, S. Wulff, Karolinska Institutet / Institute of Environmental Medicine IMM; M. Śjödin, M. Hellsträndh, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Center.

Perfluorinated alkyl acids (PFAs) are ubiquitous in the environment, specifically in aquatic systems. While several PFAs are acknowledged to be bioaccumulated by vertebrate species, including fish, their absorption, distribution, metabolism and elimination (ADME) remain incompletely understood yet. The aim of this study is to develop a physiologically based toxicokinetic (PBTK) model to simulate the absorption, distribution, elimination and excretion (ADE) of two perfluorinated substances in rainbow trout (Oncorhynchus mykiss) exposed through the diet to two selected PFASs, namely perfluorooctane sulfonic acid - PFOS - and perfluorohexane sulfonic acid – PFHxS. Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOS, since its addition to Annex B of the Stockholm convention in 2009. Two dietary exposure experiments were performed on adult rainbow trouts (O. mykiss) at two water temperatures (7°C and 11°C). Fish were fed food spiked with PFOS and PFHxS during several weeks. Then, fish were allowed to depurate, in the same tanks, where non contaminated food was supplied daily. During both phases, 5 randomly selected fish were periodically sacrificed for the analysis of the selected PFASs in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in blood were obtained by a simultaneous adjustment to experimental data. Half-lives were estimated for both compounds, in blood, at both conditions. Globally, fish acclimated to the warmer temperature showed faster absorption and elimination rates of PFOS and PFHxS, and their distribution differed between organs, suggesting that temperature represents an important factor in the toxicokinetic profile of PFAs.

**TH112**

Toxicokinetics of perfluorinated alkyl acids in zebrafish embryo

C. Vogs, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Environmental Medicine; M. Näslund, S. Wulff, Karolinska Institutet / Institute of Environmental Medicine IMM; M. Śjödin, M. Hellsträndh, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Center.

To develop an alternative test model for toxicity testing. We exposed ZFEs at three concentrations of each PFAS up to 120 hours post fertilization (hpf). The test concentrations were selected from pilot studies at which the highest would cause developmental effects in less than 20% of the embryos. Exposure medium and ZFEs were sampled separately at nine time points. Water samples from chemical controls without ZFEs present were taken in parallel. Mass-labelled internal standards specific for each PFAS were added prior to further sample treatment and analysis by LC-MS/MS. The exposure concentrations in the TK experiments differed by four orders of magnitude (PFOS< PFHxS< PFOA< PFBA). Chemical control concentrations remained constant until 120 hpf for all PFAs tested, ruling out unspecific loss due to adsorption to glass. The time courses of the internal concentrations in ZFE indicate biphasic uptake kinetics with slow uptake before hatching followed by a faster uptake after hatching. Apparent steady-state concentrations were reached at 96 hpf for PFOS, PFHxS and PFBA, while PFBA did not reach steady-state until 120 hpf. Moreover, PFOA and PFHxS (sulfonic acid end group) showed a higher bioconcentration than PFOA and PFBA (carboxylic acid end group). In conclusion, these data indicate that the functional group of PFAs, in addition to the alkyl chain length, may have an important influence on the toxicokinetic processes.

**TH113**

Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFP-DA

V. Vezeyegener, RIVM Institute for Safety and Environmental Health; C. Vogs, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Safety and Environmental Health (RIVM) / Department of Environmental Science, Karolinska Institutet.

Environmental risk limits (ERLs) were derived in the Netherlands for the substances perfluorooctanoic acid (PFOA) and hexafluoropropylene oxide dimer acid (HFPO-DA); also referred to as GenX, FRO-902 or PFOSs) (ERLs) serve as advisory values according to the guidance under the Water Framework Directive to set environmental quality standards (EQS) in Dutch policy. For these two PFAS substances, the assessment of the bioaccumulation potential is a key issue in the derivation of the ERLs. The most critical receptors are humans and wildlife, which are not only exposed directly via drinking water, but also obtain a significant part of the total exposure indirectly through their diets. For this purpose, bioaccumulation through the (aquatic and terrestrial) food chains has to be evaluated. This information is also available for PFOA, but is very scarce for HFPO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.
fluoropolymers, therefore, are distinctly different from the other polymeric and non-polymeric classes of PFAS and should be separated from all other classes of PFAS for hazard assessment or regulatory actions. Grouping all classes of polymeric and non-polymeric PFAS together for restriction or regulation is not scientifically appropriate. Fluoropolymers, as polymers of low concern, are uniquely benign PFAS.

**TH116 Fluoropolymers Are Unique, Low Hazard PFAS Needing Different Analytical and Regulatory Approaches Than Monomer Fluorinated Substances of High Health and Environmental Hazard**

B. Henry, T. Kennedy, W.L. Gore & Associates, Inc.; H. Fiedler, Örebro University, Örebro, Sweden

Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoroalkyl substance (PFAS) classes, such as perfluorooalkyl acids, or polymeric precursors that degrade to them. Fluoropolymers do not demonstrate the same toxicity or physical/chemical/thermal properties as other PFAS. Fluoropolymers, such as PTFE do not meet the criteria of PBT (Persistent/ Bioaccumulative/ Toxic) or vPvB (very Persistent/ very Bioaccumulative) chemical substances, nor do they meet the Persistent, Mobile, and Toxic (PM or PMT) substances criteria proposed by the German Environmental Agency, Umwelt Bundesamt (UBA, 2017). As high molecular weight fluoropolymers (e.g., PTFE) are benignly persistent (i.e., not mobile, bioaccumulative or toxic), all "highly fluorinated" substances do not pose equivalent health or environmental hazards and thus should not be regulated as a single class of chemicals. Chemical analytical techniques useful for differentiating one fluorinated substance from another are readily available, reliable, and reproducible and should be employed to identify and quantify those highly hazardous monomeric per- and poly-fluoralkyl substances (PFAS) individually, rather than techniques aggregating all fluorine containing substances into one group (e.g. total organic halogen, and total organic fluorine). Therefore, high molecular weight fluoropolymers, as a uniquely benign class of polymeric PFAS, require analytical and regulatory approaches differentiating them from fluorine-containing substances that present high health and environmental hazards.

**Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (P)**

**TH117 Challenges and Open Questions in Earthworm field testing**

J. Vollmer, Eurofins AgroScience Services EcoChern GmbH / Field Ecotoxicology: O. Klein, Eurofins AgroScience Services EcoChern GmbH / Ecotox Field; S. Knaebe, EAS Ecotox GmbH / Ecotoxic Field

In the risk assessment of plant protection products for in-soil organisms, the earthworm field test following ISO 11268-3 (ISO 2014) is used as the highest tier option. The test protocol is currently under revision and transition to an OECD document under the auspices of UBA (Germany), mainly focusing on improving/testing statistical approaches to control the test (e.g. effect of replication) and exploring the options to run the test in a dose-response design. In the light of the recently published EFSA opinion on in-soil risk assessment (EFSA, 2017), and with roughly 20 years of experience with the field test under the ISO guideline, other aspects of the test also might require revision, namely: Description of field site requirements (size and positioning of initial earthworm population), e.g., minimum requirements, potentially derived from typical MDD values for a given endpoint, Land-use of the field site (arable fields vs. permanent grassland): is there a preferred option, and/or does this depend on characteristics of the substance under test? Site management/ maintenance in general (soil cultivation, crop rotation vs. minimum disturbance) and more specifically in the case of testing a substance with herbicidal action (impact on vegetation coverage in test-item treated plots vs. plots of positive and negative control). Plot size and distance between neighbouring plots, plot allocation patterns, and plot separation, especially with a view on potential migration of earthworms between plots and on external re-colonization. Testing of persistent substances (e.g. how to establish a plateau concentration in soil)? Toxic reference (positive control): reduced replication for the toxic reference? Alternatives to the standard reference item Carbendazim? Examples and suggestions will be given and discussed in this contribution and areas for further research will be identified. EFSA (European Food Safety Authority), 2017: Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms. EFSA Panel on Plant Protection Products and their Residues (PPR). EFSA-Q-2011-00978, Parma, Italy. ISO, 2014: ISO Guideline 11268-3: Soil quality – effects of pollutants on earthworms. Guidance on the determination of effects in field situations.

**TH118 Regional Differences of the Environmental Risk Assessment of Pesticides in Soil with a special Focus on the European Union**

J. Kangour, National School of Engineering of Sfax, Tunisia / Laboratory of Water, Energy and Environment; J. Sousa, University of Coimbra / Department of Life Sciences; J. Roembke, ECT Okoekotoxologie GmbH
In the European Union (EU) the environmental risk of chemicals is regulated in various ways. Probably the most complex approach in place is the one for pesticides, mainly because these chemicals differ from other chemical groups by three reasons: (1) They are intended to harm organisms, i.e. those which are impacting agriculture. However, many of the pest species affected by pesticides belong to the same taxonomic groups being responsible for many soil functions and services. (2) They are also directly distributed in the environment, usually by spreading on soil but also spread in various other ways such as a coating on seeds or material. (3) Since their effects are supposed to act only against the pests, when being applied regularly the amount of pesticides ending up in the environment is high. Due to the long experience with this very detailed approach the results of the EU ERA for pesticides are often taken over by other countries (e.g. in Africa). But is this procedure reliable? This contribution focuses on the soil compartment and tries to tackle the following questions: (1) Can (and if yes: how) regional differences (e.g. regarding ecological or agricultural factors) influence the performance or the outcome of pesticide ERA? (2) How do ecological and agricultural differences influence the pesticide ERA within the European Union? Our findings show that regional differences in abiotic, biotic and anthropogenic factors can affect the fate of pesticides in soil as well their effects on soil organisms, meaning that these differences should be considered in pesticide ERA. Proposals will be made how to improve the ERA process but keep it at the same time practical (e.g. by using a tiered approach). These ideas will include the selection of representative reference soils and test conditions for Mediterranean regions. In addition, we will discuss whether the range of standard test species used so far is sufficient. In this context contaminations caused by fertilization will be considered. This data is soil statistically evaluate helpful. Based on the answers to these questions it will be discussed whether (and if yes, how), the ERA of pesticides has to be modified for Mediterranean regions (both inside and outside of the European Union).

TH119 Adaptation of the earthworm field test method: conceptual overview and first results

J. Roembke, ECT Oekotoxikologie GmbH; B. Daniels, RWTH Aachen University / Institute for Environmental Research Institute; B. Förster, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; R. Oertmanns, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; A. Schieffczyk, ECT Oekotoxikologie GmbH; B. Scholz Starke, RWTH Aachen University / Institute for Environmental Research

In 2016, the German Federal Environment Agency (UBA) launched a project entitled “Necessary adaptations of the standard Earthworm Field Test” to improve the scientific basis when transferring the ISO 11268-3 (1999) guideline to a new OECD standard. As a first step, a literature search was performed to compile available data from earthworm field tests, both from the open literature and from anonymous studies used for regulation. This data is soil statistically evaluate helpful. Based on the answers to these questions it will be discussed whether (and if yes, how), the ERA of pesticides has to be modified for Mediterranean regions (both inside and outside of the European Union).

TH120 Soil ecotoxicology and ecological risk assessment in southern African mining landscapes

M. Mabogunje, North-West University / Unit for Environmental Sciences and Management; H. Ejisakkers, WUR/NWU

Although there has been a remarkable development in the field of soil ecotoxicology and risk assessment (RA) models, it is debatable if these RA models are representative enough in order to utilise them on larger spatial scales, attuned to specific landscapes and ecosystems worldwide. An example of this is southern Africa where some soil ecotoxicological research has been done. To address this we will present the results of: An inventory of research on the ecotoxicity of metals toward soil life in southern Africa as an example, focussing on southern African soils, soil life and living conditions. The outcomes of an analysis of the geographical surroundings of gold and platinum mine waste deposits in South Africa The field study of open coal mining in and near a national park in Swaziland It is concluded that there is a limited body of information on southern African soil life, and most of these were laboratory based studies done by a small group of researchers. Future research with regards to incorporating the information available into a soil ecosystem assessment procedure is needed and recommended. It is recommended that a starting point to address this might be the development of site-specific guidelines for Ecological Risk Assessment (ERAs) taking into account landscapes, vegetation and faunal characteristics. From our studies in the surroundings of platinum and gold mine waste, we conclude that these wastes still contain considerable amounts of other chemical elements. The extraction methods, moreover, result in very alkaline or acidic conditions. Further the mine waste is very fine grained and therefore susceptible for wind erosion. Consequently these wastes, given the prevailing wind conditions in these areas, will be dispersed over a wide area causing risks for organisms in natural and built areas surrounding these deposit areas. The coal mine study illustrates that mining in or around natural protected area cause risks due to the irradiating impacts of wind and surface and ground water dispersal form the mined area. Therefore ERA should start to assess the impacts on the natural ecosystems present in the area, and compare these with the outcomes of a Potentially Affected Fraction of species PAF analysis.

Keywords: soil ecotoxicology, ecological risk assessments, mining, southern Africa

TH121 Establishment of tiered risk assessment approach of pesticides for soil in China

J. Jiang, Nanjing Institute of Environmental Sciences, MEP; J. Zhou, Nanjing Institute of Environmental Sciences, MEP

The aim of the risk assessment for soil organisms is to prevent negative acute or long-term effects on soil functions and functionally most important species. The risk assessment approach established in China considers ecologically relevant groups of soil organisms, considering the pesticide transformation processes involved in a range of soil functions providing essential ecosystem services, e.g. organic matter breakdown and mineralization, water regulation in soil. The tiered approach is a valuable tool to quickly identify those pesticides which do not pose acute or chronic risk (in a certain area of ecotoxicology) on soil organisms – even under worst case assumptions, and to identify those that need more attention and further evaluations. All risk assessments presented are based on Risk Quotients (RQ), calculated by dividing the Predicted Environmental Concentration (PEC) by the Predicted no Effect Concentration (PNEC). This calculation takes into account, that beside the toxicity of a pesticide, the amount of this pesticide in the environment plays a major role when assessing a risk. If RQ > 1, the risk is unacceptable and higher tier risk assessment should be conducted. Tier 1 exposure analysis employs simple model (PECsoil-SFO, China from NIES) to predict exposure to soil organisms. A higher tier exposure analysis can be applied by refining environmental exposure parameters or using semi-field trial test. Currently, the models PRAESS and China-PEARL, which developed by NIES and ICAMA in China, are applicable to predict the exposure concentration at specific depth of soil layer and at specific scenarios in China. Proposed test systems for effect assessment include acute toxicity test or reproduction of earthworm, reproduction test, nitrogen transformation test, litterbag test and earthworm field test. The PNEC can be calculated using the endpoint obtained from ecotoxicological studies and corresponding uncertainty factors (UF). Tier 1 risk assessment mainly focuses on the earthworm acute or earthworm and soil microorganisms which involved assessment and N- transformation assessment. High tier risk assessment mainly focusses on the litterbag test assessment and earthworm field assessment. We have used this tiered risk assessment approach to assess the risk of more than 40 common used pesticides in China. Keywords: tiered, risk assessment, pesticide, soil organism

TH122 Ecological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks

M. Haver-Kiisinga, Eurofins-Mitot; S. Aldershot, Bioresearch and Evaluation; F.M. Bakker, Eurofins-Mitot

Terrestrial non-target arthropods exhibit a vast array of life history strategies and migration tactics. However, their home range is rather small, and thus, they are a good model group to investigate the factors which influence ecological recovery in risk assessments. Arthropod communities are not stable, but the numbers of species and individuals per species fluctuate over time and space. Part of the variability may be due to the initial disturbance of the application parameters, but could be intrinsic or due to biological interactions, as individuals are embedded in complex food and interaction networks. However, the recovery of a network depends on the fact that all ecological and functional roles within such a complex entity are still realised by a certain number of species (and their individuals). Usually, only abundance criteria are applied in ecological recovery investigations. For example, if numbers of individuals trapped are similar to a control group on two subsequent occasions, recovery is concluded upon. But if the proportion of one functional role (e.g. predators, parasitoids, pollinators or herbivores) in the focal group is far below the proportion of the same functional group in the control group, recovery is not
completed, and the stability of the network in focus might be imbalanced. On the other side, abundance might be different to the abundance in the control group, because of a phase shift due to the initial disturbance, but the proportional distribution of functional roles still mirrors the control group. Thus, we feel that pure abundance data are not enough to understand ecological recovery, but suggest to use additional knowledge about the involved species and their interaction network, like the functional roles and their proportional distribution within a community. Investigating the ecological recovery of a community using information from field work and experiments together with additional information about the species and their importance for and embeddedness in the ecological network is of high importance for a better understanding of the ecological recovery of communities.

TH123 Comparing effects of fludioxonil on non-target invertebrates using ecotoxicological methods from single-species bioassays to model ecosystems G. A. Härö, H. Räsänen, University of Helsinki / Department of Biology; S. Hõdes, Ecossa / Animal Ecology; W. Traunspurger, University of Basel / Animal Ecology. Lower tier toxicity testing used for risk assessment of plant protection products (PPPs) is conducted with single species. Information from such toxicity tests are, however, limited to direct effects of the respective tested substances. Although the uncertainties regarding the protectiveness of these tests for in-situ communities are known, informations on effects of PPPs on community-level of non-target organisms are scarce. Model ecosystems, i.e. microcosms, are suitable to bridge this gap between single-species tests and field studies since they provide controlled experimental conditions and are able to demonstrate direct and indirect effects of the respective substances. In the present study, single-species toxicity tests and soil-spiked microcosms were used to comparatively investigate the toxicity of the non-systemic fungicide fludioxonil (FDO) on non-target soil organisms. Regarding soil invertebrates, nematodes are among the most abundant metazoan organisms and hence used as components to represent mesofauna. Nematodes are suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg⁻¹ (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of ~1 dw, which is comparable to the 28-d NOEC of Chimorimon riparius in sediments (40 mg kg⁻¹ dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg⁻¹ dw) and 28-d NOEC of Folsomia candida (125 mg kg⁻¹ dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg⁻¹ dw), Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

TH124 To what extent do soil micro-arthropods facilitate OM breakdown in an arable field soil? - Implications on specific protection goal setting for soil risk assessment of plant protection products G. S. A. Harkin, B. S. Bayliss, J. F. Bell, Dow AgroSciences; T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsisit, ADAMA; S. Loutsiou, DuPont De Nemour Hellas S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O’Neill, DuPont Crop Protection; A. Sharples, FMC Agricultural Solutions; F. Staab, BASF SE. Soil functional test systems provide valuable and ecologically relevant information for the risk assessment of plant protection products (PPP). Functional tests directly measure ecosystem functions and services which are provided by soils and soil organisms (e.g. organic matter (OM) degradation and mineralization). Focusing on structural endpoints in the risk assessment for PPP lacks a clear link to the protection goals derived from ecosystem services. Directly measuring soil functions and services would provide a better understanding of the fertility of soils. Furthermore, functional test systems can help to evaluate the ecological relevance of a density change of a soil organism population affected by a certain stressor. To quantify the soil mesofauna and microorganism contribution to the breakdown of organic matter (OM) degradation, a minicontainer test. Soil micro-arthropod abundances were monitored in parallel to determine the link between effects on the structure of soil micro-arthropods and their soil functional implications (i.e. OM breakdown). The results indicate that the process of OM degradation is dominated by soil microbes. Soil mesofauna contributed only a minor amount to OM degradation. The minicontainer test did not show a clear effect of insecticides on the mesofauna driven organic matter degradation, although total abundances of Collembola and Acari were heavily reduced by the insecticide applications. In the recently published Soil Scientific Opinion (2017), EFSA proposed Specific Protection Goals for soil micro-arthropods in field areas. This foresees that even short-term effects on single species in a magnitude of >65% are considered unacceptable to ensure the provision of Ecosystem Services in agricultural soils. The present study shows that a reduction of the total soil micro-arthropod community by 80% over a period of 6 months has no unacceptable effect on the mesofauna driven OM degradation in a minicontainer test on an arable field. Thus, the relevance of the structural endpoint on soil micro-arthropods (i.e. single species populations) within an in-field soil risk assessment for PPP, which focus on maintenance of soil fertility (protection of soil functions), is questionable.

TH125 The role of source sink dynamics in the assessment of risk to non-target arthropods from the use of plant protection products G. Lewis, JSC International Ltd; S. Brauker, BASF France S.A.S.; C. Mayer, BASF SE / Ecotoxicology. The concept of source-sink dynamics as a potentially important component of metapopulation dynamics was introduced in the 1980’s culminating in the paper by Pulliam (1988). Since that time, a considerable body of work has developed to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issue does raise important questions pertaining to the role of source-sink dynamics in the assessment of risk to non-target arthropods in the context of the risk from the use of plant protection products. It is therefore important to consider what the evidence base is for source-sink dynamics in the agricultural environment and what this tells us about how or whether it is manifested in relevant populations. A structured approach can then be adopted in terms of identifying suitable surrogate species and generating the necessary information for them and at the landscape scale to allow the development of suitable population models. These models could then be used in an appropriate way within a risk assessment scheme e.g. at a higher tier level addressing specific issues of concern identified at the lower tiers. They may also have the potential to inform risk managers to consider the implications for landscape management. Practically, this paper highlights the amount of information needed in relation to the life-cycles of non-target arthropod species and landscape structure, are also identified. Acknowledgements: This work was initiated and funded by the ECFA non-target arthropod group

TH126 Classification of uncertainty in ecological risk assessment of pesticides A. Hunka, Halmstad University / School of Business, Engineering and Science; M. Meli, ADAMA Agricultural Solutions; S. Pashmini, S. Waara, Halmstad University. Uncertainty estimates are inherently built into any prospective risk assessment. Uncertainties need to be correctly recognized, described and presented to provide a basis for decision-making. One important factor to consider is that more data and extended results often require an increased dependency on assumptions which may limit the robustness of the model. The aim of this work is to link the typology of uncertainties with the lower tiers. They may also have the potential to inform risk managers to consider the implications for landscape management. Practically, this paper highlights the amount of information needed in relation to the life-cycles of non-target arthropod species and landscape structure, are also identified. Acknowledgements: This work has been sponsored by the EFSA non-target arthropod group.

The German Federal Soil Protection Act (1988) defines precautionary values for seven metals which, if exceeded, indicate that concern for a harmful soil change exists. All precautionary values given in the German Soil Protection Ordinance (1988) are based on total concentrations (aq:water). However, a realistic risk assessment of metals should consider their bioavailability in soil. Thus, the aim of this project is to connect bioavailable fractions of arsenic with ecotoxicological effect concentrations, taking into account soil properties (texture, pH, organic matter content etc) and various metal extractions (1M NH4NO3, 0.1M CaCl2, Ca(NO3)2 with ionic strength corresponding to soil solution, DTPA/CuCl2, 0.43M HNO3, plus aqua regia). Arsenic was chosen due to its high relevance as a soil contaminant, its low data availability compared to other metals and is an element of concern included in many soil regulations. Six soils covering a wide range of Central European soil properties were chosen and spiked with sodium arsenate dibasic heptahydrate (Na2HAsO4•7H2O). Chronic toxicity endpoints were tested with microbes, plants and invertebrates, according to ISO standard guidelines, along with derivation of threshold values via an SSD approach. The results (given as NOEC, EC10 and, preferably, EC20 values), based on the six extraction methods, have been determined. The variation in EC10 values based on nominal concentrations among the soils tested differed typically by a factor of 2 - 5 for the endpoints tested. The extraction strength of the different methods and soils differ at least by an order of magnitude in the order NH4NO3 < CaCl2 < Ca(NO3)2 < DTPA < CuCl2. For most soils, plants were the organisms reacting most sensitively, partly together with the Bacteria. In contrast, the invertebrate species were always less sensitive (i.e. EC50 values (nominal concentration) > 250 mg As/kg soil) than microbes and plants except in one sandy soil (RefSoil-01A). Currently, chemical and biological results are combined in order to explain the observed variation in toxicity expressed as nominal or total As concentrations in soil. This information will be used to include As bioavailability into the derivation of precautionary values. The representativeness of the different extraction methods regarding bioavailable fractions as well as the properties of the different soils are checked as part of a more realistic risk assessment of metals in soils.

Activity based in-soil arthropod sampling S. Dehelean, F.M. Bakker, Eurofins-Mitox

Higher tier (field) assessment of effects on soil microarthropods relies strongly on the accuracy of the sampling methodology. Two main classes of trapping methods exist to date, these are either abundance-based or activity-based. Abundance-based trapping directly involves the collection of soil invertebrates followed by heat extraction such as Berlese-Tullgren or McFayden methods. Activity-based sampling implies installing hypogean traps and collecting the catch at pre-determined intervals. Soil core sampling provides an instantaneous assessment of the fauna at the exact moment and at the very location of sampling, whereas hypogean traps provide an assessment of the activity in a wider area and over a longer time span. Clearly, high throughput is a better activity based alternative. Soil core sampling is an established and recommended method known to extract springtails, mites and some other small arthropods. Hypogean trapping is a relatively novel approach (cf Dehelean et al. SETAC 2016, Sims et al. 2016, Bakker et al. 2017) and seems to have a certain degree of selectivity. For purposes of method development and evaluation we have performed a comparative study in which soil core sampling and hypogean trapping (mine traps) were performed in the same fields. The study comprised both a hay meadow and an arable field. Soil cores were taken from the top 10 cm of soil, mine traps collected from various depths. With this contribution we will highlight the differences in species spectrum, numbers collected and variability observed with the different methods and discuss the implications for data analysis and interpretation.

The application of the CPCAT approach reduces shortcomings of effect detection for earthworm field studies B. Daniels, RWTH Aachen University / Institute for Environmental Research; S. Jansch, ECT Oekotoxikologie GmbH; P. Ottermanns, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; M. Ross-Nickoll, B. Scholz-Starke, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research

Field studies to determine effects of pollutants on earthworm community are generally conducted according to standardized ISO-guidelines (ISO 11268-3). However, statistical test procedures suggested in the guidelines are frequently criticized, mainly for two reasons: test data characteristics do not fulfill test requirements (normal distribution and variance-homogeneity) and the resulting toxicity metrics of multiple testing procedures (NOEC / LOEC) fail to adequately detect the actual level of effects. Lehmann et al. (2016) presented a new approach to overcome these shortcomings by introducing the CPCAT procedure. We applied this statistical method to detect effects in a set of 16 earthworm field studies and provide a comparative analysis with regard to results of well-established multiple testing approaches. This will help to perform the performance of CPCAT assessed with an comprehensive meta-analysis of field study data. Raw data of biomass and abundance on sample level (0.25 square metres) were extracted from original study reports and assessed on sample and plot level. In total, data of 17 different earthworm species, ecological and morphological groups as well as total abundance and biomass for 1-3 treatments and 3 sampling dates after application within test duration of one year were analysed. This led to a total of 4215 comparisons for the detection of differences between control and treatments. We demonstrate that the distribution of both endpoints abundance and biomass can be described by a Poisson model, which is a requirement for the application of CPCAT (variance homogeneity -often not fulfilled in toxicity tests- is not a prerequisite of CPCAT). The number of endpoints showing a significant difference between control and treatment was compared to the outcome of parametric test procedures (pairwise t-test, Dunnett and Williams t-test for multiple testing). The study reveals that the application of standard multiple testing procedures leads to a disguising of possible effects due to relatively high differences to be achieved between control and treatments. This consequently results in uncertainties regarding the actual level of effects at the NOEC. The CPCAT approach offers a more powerful and statistically meaningful response than the determination of field studies because data distribution and variance are adequately considered and smaller differences between control and treatments can be detected.

Relationship between soil microbial biomass methods used in environmental fate laboratory studies P. Massey, Smithers Viscent; P. Pearson-Davies, B. Earnshaw, Smithers Viscent; S. Swales, Smithers Viscent ESG Ltd

The determination of microbial biomass activity is a pre-requisite for OECD laboratory studies that are designed to investigate the environmental fate of chemicals in soils. By determining soil microbial biomass prior to, during and after a study, the viability and suitability of the experimental soil can be demonstrated. Choosing the appropriate methodology for soil microbial biomass is critical for conducting successful environmental fate studies. One common method, referenced in the OECD guidelines, for determining soil microbial biomass is the fumigation extraction method. This method determines the carbon content of the soil biomass, via carbon fixation, using ethanol-free chloroform. During fumigation, cells are lysed by the chloroform, which results in a flush of organic carbon into the soil environment. This organic carbon is then extracted and quantified. Another suitable way of estimating soil microbial biomass is by substrate induced respiration. This method uses a suitable substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory response is then used to determine microbial biomass size can then be determined by relating respiration and fumigation extraction data. In spite of there being multiple recognised ways of determining soil microbial biomass, it is important to recognise that they reflect different aspects of the soil microbial community. One fundamental difference between these methods is that they can potentially distinguish between active and non-active components of the biomass. As noted in OECD 14240, substrate induced respiration can be used to estimate the active aerobic biomass, whereas in OECD 14240:2-1997, fumigation can extract carbon from both active and non-active biomass components. With such differences between methods, it is important to consider which method is more appropriate for determining soil suitability for environmental fate laboratory studies. Work is currently being undertaken by Smithers Viscent to investigate the relationship between the soil microbial methodologies commonly used for laboratory soil studies. The aim of this work is to better understand how the choice of soil biological methods relates to soil suitability, which will ultimately facilitate and refine our choice criteria when choosing soils for environmental fate studies. 

Where are the Springtails? New data on the vertical distribution of Folsomia candida (Colembola) and its population dynamic in artificial soil L.S. Tschope, RWTH Aachen University / Institute for Environmental Research BioV; V. Röben, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research BioV; M. Rob-Nickoll, RWTH Aachen University / Institute for Environmental Research Folsomia candida is a non-target arthropod species which is often referred as the "Standard Soil Arthropod" (Fountain and Hopkins, 2005). It is part of the regulatory framework of pesticide risk assessment and in the last years an increasingly important model organism in ecological and effect modelling. However, the knowledge on the population dynamics on a long-term scale and the vertical dispersal within the soil column is still scarce. We will present the results of two experimental studies exploring those unknown topics – one on the population dynamics over time and one on the vertical dispersal in relation to food location.
The population dynamics experiment is a one-year study assessing the dynamics of *Folsomia candida* in artificial OECD soil at constant 20°C. The study started with 25 individuals of different age classes in 100 g OECD soil. Since then the population increase was measured on at least a monthly basis with five replicates per testing day. The food regime is adapted to the increasing population density to make sure that the maximum population level is achieved during the study. We will show a fast growth at the beginning of the experiment and expect to reach an oscillation in its maximum at the end of the study. In a second experiment the vertical dispersal of *F. candida* in relation to food location is investigated. Transparent PVC columns were filled with on average 350 g of OECD soil up to a level of 20 cm soil column height and 86 *F. candida* of different age classes. Each column was closed with Parafilm on top and a gauze on the bottom with a small water reservoir beneath it to avoid desiccation. The initial humidity was set to 50% of the maximum water holding capacity of the soil. The columns were separated into six compartments at different heights: 1, 2.5, 5, 10, 15 and 20 cm. Septa in the middle (4th) and bottom (6th) compartment allowed for watering and feeding. We varied the location of feeding by four different regimes while all other parameters were kept constant. The columns were provided either with food in the top, the bottom or the middle, in the ground or at all three compartments. Our hypothesis is that food is a main trigger for the vertical distribution of *F. candida* in soil. Two of three large examination dates have been processed so far. The data confirms our hypothesis and the results of the study will present new data for the otherwise well investigated Collembola species *F. candida.*

**TH132**

Why zinc doesn't matter: habitat quality drives invertebrate response to zinc, not concentration  
S. Siciliano, University of Saskatchewan / Department of Soil Science; K. Jegede, H. Fujana, University of Saskatchewan Toxicology Centre  
The responses of organisms in soil ecotoxicity tests are often determined by the bioavailable concentrations of contaminants they are exposed to. However, the direct effect of habitat quality on the performance or response of organisms in different contaminated soils is often neglected. Habitat quality is a measure of extent to which habitat promotes individual and population fitness. This study assessed the effect of habitat quality on mite, *Oppia nitens* exposed to different contaminated soils which was corrected for bioavailable metals. Forty-seven (47) soils were ranked into habitat quality by summing up the scores of enchytraeid and collembola survival and reproduction with the plant biomass in each of the soils. From the 47 soils, 18 soils were divided into three habitat quality groups based on high, medium and low habitat quality. The 18 soils were dosed with low to high concentrations of zinc and mites exposed to the soils for 28 days. Mite survival, reproduction and the top bioavailability of zinc were determined after 28 days. Habitat quality did not change zinc bioavailability which remained a constant across all three habitat indices. Instead, mite fitness improved with increasing habitat quality and mites were able to tolerate higher zinc body burdens in better habitat qualities. Furthermore, the zinc response (measured as the slope of the EC50) was more pronounced in lower habitat qualities. Our data suggest that habitat quality is more important than metal concentration for soil protection. Ecorestoration, rather than remediation, will likely be a more effective means of ameliorating zinc toxicity.

**TH134**

Effects of atmospheric hydrogen chloride and ammonia on Parachytricus kimi (Collembola : Onychiuridae)  
J. Weg, J. Son, Korea University / Division of Environmental Science and Ecological Engineering; Y. Kim, Y. Lee, J. Hong, M. Lee, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering  
As the use and distribution of various chemicals increases, there is a possibility of chemical accululation in soils. In Korea, the incidence of chemical accidents is also increasing. Damage caused by chemical accidents is not only widespread but also has a long-term impact, making it difficult to predict damage and respond appropriately however, there are very few studies on chemicals that can cause accidents. Especially for chemicals exposed to gaseous state, little is known about the soil bioaccumulations such as Collembola and earthworm. The experiment was carried out in PS container filled with 30g of soil according to modified OECD 232 guidelines. Investigating the effects of gaseous hydrogen chloride and ammonia on *Parachytricus kimi* (Collembola), the test vessels with *P. kimi* were exposed to two different concentration of toxic substances in the enclosed chamber for 20 minutes. After exposure, the test vessels with *P. kimi* were transferred to an incubator (20°C, continuous darkness) in a closed state, and the mortality and reproduction rate of *P. kimi* were observed after 1 hours, 2 weeks, and 4 weeks. There were no deaths after 1 hour, but the mortality rate was increased over time from 2 weeks. Also, after 4 weeks, the number of juveniles produced by adults *P. kimi* were decreased as concentration-dependent manner. These results show that the long-term effects of gaseous phase chemicals can occur at concentrations that are not acutely affected.

**TH135**

Toxicity assessment of methyl ethyl ketone using earthworm and soil algae  
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science  
Methyl ethyl ketone (MEK) is a kind of ketone-based volatile organic compound and widely used as industrial solvent. There is a high possibility of leakage of this compound into soil environment, but few studies for ecotoxicity of MEK were present. This study evaluated the toxicity of MEK using earthworm *Eisenia andrei* and algae *Chlamydomonas reinhardii* and *Chlorococcum infusionum.* *Eisenia andrei* were exposed with liquid of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including swelling, fragments, weakening, bleeding, and mucous secretion were measured. For soil algae, *Chlamydomonas reinhardii* and *Chlorococcum infusionum* were exposed with 2.5 g of control or MEK soils in 15 mL glass test tube, and chlorophyll intensity was measured after 6-day exposure. As results, 7d-LOEC and 7d-EC50 of MEK to *Eisenia andrei* were calculated as 1136 mg MEK/kg dry soil and 1910 (1643.00-2211.58) mg MEK/kg dry soil, respectively. For soil algae, *C. infusionum* was more sensitive than *C. reinhardii for MEK, 6d-EC50 to *C. reinhardii* and *C. infusionum* were calculated as 3400.44 (3132.01-3690.94) mg MEK/kg dry soil and 60.97 (51.19-72.62) mg MEK/kg dry soil, respectively. These results can be used for risk assessment of MEK in soil ecosystem. *This work was supported by Korea Environment Industry & Technology Institute (KEITI) through "The Chemical Accident Prevention Technology Development Project" funded by Korea Ministry of Environment (MOEJ) No. 2016001970001)*.  
**<strong>Key word: methyl ethyl ketone, earthworm, soil algae</strong>**  

**TH136**

Effects of endocrine disrupt compounds (EDCs) to soil algae  
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science  
There were many data for endocrine disrupt compounds (EDCs) for aquatic organism, but soil toxicity data of them were very limited. This study evaluated the effects of bisphenol A (BPA), bis(2-ethylhexyl)phthalate (DEHP), and nonylphenol used in industry. Soil algae *Chlorococcum reinhardii* and *C. infusionum* were exposed at 0.5 g of control or exposed soils in 6-well plate. Algae were extracted for 1 day using algae culture medium after 6-d exposure, and the chlorophyll intensity was measured by fluorescence microplate reader. We observed that the BPA was most toxic following NP and DEHP. The effect of DEHP was insignificant to *Chlamydomonas reinhardii* and *Chlorococcum infusionum.* The results can be used for risk assessment of BPA, DEHP and NP in soils.  
*This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458)*  
**Key word: bisphenol A, bis[2-ethylhexyl]phthalate, nonylphenol, soil algae**

**TH137**

Evaluation of reproduction tests of earthworms and enchytraeids exposed to sugar cane vinasse in natura and after pH adjustment  
C.M. Sousa, São Paulo State University / UNESP / Biology; C.P. de Souza, Sao Paulo State University / UNESP / Biology; H. Soares-Lima, Universidade Estadual Paulista Júlio de Mesquita Filho- Unesp- Rio Claro / Departamento De Biologia, Centro de Estudos de Insetos Sociais; A. Marcatto, Sao Paulo State University / UNESP / Department of Biology; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Sousa, University of Coimbra / Department of Life Sciences; C.S. Fontanetti, Sao Paulo State University / UNESP / Biology  
The use of sugarcane vinasse as fertilizer in crops has been widely used in order to provide an adequate destination for this residue however, it has properties that can be prejudicial to the animals present in the soil, as already verified in numerous studies. Therefore, the objective of this work was to treat vinasse with lime (CaO) to adjust pH to 7.0 (neutral), in an attempt to reduce its toxicity for later use in the soil. In this context, the development of ecotoxicological tests presents itself as a tool of great assistance in the analysis of residues released to the soil. Thus, reproduction tests were conducted using animal soil biondicators to evaluate the effects of vinasse may have on reproductive behavior of these animals. Earthworms of the species *Eisenia andreii* (Annelid) and enchytraeids of the species *Enchytraeus crypticus* (Annelida); both tests were developed according to the protocols proposed in ISO 11268-2 (ISO, 2011) and ISO 16387 (ISO, 2013), respectively. In general, the results showed that vinasse in natura in comparison to the animals exposed to the treated vinasse there was an increase in the number of animals, which suggests that the vinasse treatment for pH adjustment was valid for this test. The reproduction test with *E. crypticus* exposed to the same conditions cited above also showed an increase in the number of individuals exposed to treated in biosaas vinasse compared to exposed to vinasse in natura. The results allow to infer that the pH adjustment of the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction both in both species used, since the environment favored the reproduction of the animals tested.

**TH138**

Ecotoxicological Characterization of Nitrogen-Based Energetic Soil Contaminants  
R.G. Kuperman, Edgewood Chemical Biological Center / Molecular Toxicology Branch, R. Chekai, U.S. Army Edgewood Chemical Biological Ctr / Molecular Toxicology / Environmental; M. Simini, U.S. Army Edgewood CB Center / 450 SETAC Europe 28th Annual Meeting Abstract Book
Environmental Toxicology

We provide an overview of ecotoxicological effects of nitrogen-based energetic materials (EM) of notable ecological concern, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and 2,4,6,8,10,12-hexanitro-2,4,6,8,10,12-hexaaza-sowuzitronate (CL-20), 2,4,6-trinitrotoluene (TNT), 1,3,5-trinitrobenzene (TNB), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-ADNT), 4-amino-2,6-dinitrotoluene (4-ADNT), and nitroglycerin (NG). Ecotoxicological effects of these EMs were determined in definitive studies with Sassafras sandy loam (SSL) soil using soil invertebrate, terrestrial plant, and biological activity endpoints. SSL soil was selected because it has physicochemical characteristics (loamy, organic matter very high relative to sand or clay) and bioavailability of organic chemicals. Data for reproduction (soil invertebrates), growth (plants), and critical soil processes (basal and substrate-induced respiration, litter decomposition) were independently analyzed using appropriate regression models to determine the EM concentration producing 20 percent decrease (EC20) in the measurement endpoint compared with carrier (acetone) control. Ecotoxicological benchmarks developed in studies with soil invertebrate and terrestrial plants were used to derive draft Ecological Soil Screening Levels (Eco-SSLs) for use in screening-level ecological risk assessment of EM-contaminated soils.

Additionally, we developed species sensitivity distributions (SSDs) for select EMs using toxicity data for all three soil ecological receptor groups (invertebrates, plants, and soil processes). These SSDs were then used for derivation of Soil Covariate Values (SCVs). Based on data from soil invertebrate and Eco-SSL values developed in these studies will be submitted to the USEPA Eco-SSL Work Group for use in establishing soil invertebrate- or plant-based Eco-SSLs for the individual EMs, and will be made available for use in Ecological Risk Assessment of terrestrial habitats at U.S. Army testing and training sites and other military locations. The SCVs can provide site managers and regulators with a risk assessment tool which allows them to identify fractional effects for specific soil media (e.g., HC5 or HC95 protection level) that they wish to use to derive a site-specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH139 Organic responses of oligochaetes in bacterial inoculum amended copper oxychloride spiked soils

M. Maboeta, North-West University / Unit for Environmental Sciences and Management; O. Oladipo, M. Engelbrecht, North-West University

The excessive release of heavy metals such as copper via anthropogenic sources into the soil environment has raised some global concern. Copper oxychloride, a common agricultural-based fungicide applied to fungi outbreaks for fungal control, contains 60% copper. This high copper content may significantly contribute to the soil copper burden and negatively affect the mesofauna. Metal-tolerant bacteria such as Bacillus cereus strain have been identified for their bioremediative traits in metal polluted soils. We examined the effect of Achromobacter spanius - Bacillus cereus consortium on the ecotoxicity of copper oxychloride and inorganic Cu ions using the most resistant strains. To achieve this, the bacterial strains used (Achromobacter spanius and Bacillus cereus) were previously isolated from gold and gemstone mining sites and confirmed to tolerate at 200 mgkg⁻¹ Cu. Twenty-four hours pure broth cultures of the two bacterial strains were inoculated into fungicide spiked soils. Utilizing standard ISO and OECD protocols, 10 mature Eisenia fetida and Enchytraeus albidus adults were exposed separately into both organic and inoculated copper oxychloride spiked soils and 1000 mgkg⁻¹ Cu. Avoidance behavior, biomass, reproductive success, metal contents in soils and earthworm tissues were determined. Findings revealed that E. andrei in inoculated substrates (200 mgkg⁻¹) exhibited significantly higher (p < 0.05) preference, relative growth rate, survival, cocoon and juvenile counts and soil Cu content (comparable to the control) than non-inoculated soils. Similarly, with the E. albidus, significantly higher (p < 0.05) preference and reproductive success was recorded. However, at 1000 mgkg⁻¹ copper oxychloride soils, no distinct effect was observed on both E. andrei and E. albidus in bacterial inoculated and non-inoculated substrates. In conclusion, Achromobacter spanius - Bacillus cereus bacterial consortium decreased the ecotoxicity of metal-based fungicide towards Eisenia fetida and Enchytraeus albidus, split into micrograins, copper oxychloride concentrations. These results further confirm the Cu biomass potential of these bacterial strains at 200 mgkg⁻¹. Achromobacter spanius and Bacillus cereus are therefore recommended for the bioremediation of soil contamination of copper contaminated environments. Keywords: Copper oxychloride fungicide. Achromobacter spanius - Bacillus cereus consortium. Ecotoxicity. Oligochaetes in a simplified soil solution system under the assumption that soil pore water is the main route of exposure to metals. After 7 days of exposure, survival and internal metal concentrations in P. kimi were determined. The free metal ion activity for each metal was calculated by the Visual MINTEQC using inputs of soil metal concentrations, cation and anion components of the soil solution, and pH of the soil solution. The toxicity of cadmium and zinc was linked to the fraction of biotic ligands bound to free metals (i.e. Cd²⁺ and Zn²⁺). The results showed that the fraction of the biotic ligand occupied by metal can be used to predict the metal toxicity, indicating the applicability of TBLM to explain metal toxicity to P. kimi in a simplified soil solution. Although the approach used in this study may be limited to soil solution, the use of TBLM can be a useful tool for investigating factors bioaccumulation and toxicity of metals.

TH141 Characteristics of metal-tolerant bacterial plasmids from a platinum mine tailings dam

T. Mahalati, C. Beznuidenhout, M. Maboeta, North-West University / Unit for Environmental Sciences and Management

The presence of mine tailings has promoted the development of both heavy metal and antibiotics resistance among microbes with resistant plasmids. Plasmids provide their hosts with a large array of phenotypes such as heavy metals and antibiotics resistance due to gene transfer. This study describes the characteristics of plasmids isolated from various bacteria that displayed an ability to withstand high metal concentrations. Isolated plasmids were individually transformed into Escherichia coli JM109. The frequency of transformation was determined for each bacterial strain. Achromobacter spanius. Bacillus cereus, and Enchytraeus albidus strains were used for further plasmid capabilities using a microdilution approach where the plasmid DNA concentration ranged between 11.75-118.06 ng/μl after extraction. Incompatibility groups were determined by subjecting plasmids to PCR amplification using IncN, IncP-9 and IncW specific primers, where only IncW provided positive results. Minimum inhibition concentrations (MICs) were carried out to determine the ability of transformed E. coli JM109 to tolerate metals at varying concentrations. Results indicated that transformed E. coli JM109 developed ability to grow in the presence of several heavy metals. Some strains were resistant to high concentrations (+10 mM) of Ni⁴⁺/⁵⁺, Pb²⁺ and Ba²⁺ with metal resistance order of Ni⁴⁺/⁵⁺>Pb²⁺>Ba²⁺. Metal-tolerant bacterial plasmids from a platinum mine tailings dam. However, Neanuridae species, which is one of the family of Collembola, are rarely characterized have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnology potential.

TH142 Sensitivity of the waterside species, Yuukianura szwyckyi (Collembola: Neanuridae), to cadmium and copper

Y. Lee, Korea University; J. Wee, J. Son, Korea University / Division of Environmental Sciences and Ecological Engineering; Y. Kim, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

Collembola is the most abundant organism in the soil ecosystem and some species are used as ecotoxicological evaluation species for toxic substances in soil. However, Neanuridae species, which is one of the family of Collembola, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of copper and cadmium of Yuukianura szwyckyi, known as the species in which they live water flies, and their biomass accumulation were examined based on the ISO guideline 11267. After 28 days of exposure to tested metals, LC50 for adult survival and EC50 for reproduction were estimated. These toxicity values of Y. szwyckyi were also compared to those of other collembolan species (F. candida and Paracyrhyzium kiri) reported in literature to investigate their suitability as a new test species in toxicity test. Not only the adult survival but also the juvenile reproduction of Y. szwyckyi was used in a combination dependent manner after 28 days of exposure duration. Although the response of Y. szwyckyi to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of Y. szwyckyi to chemicals in the soil is considered to be very important. Because their special habitat can provide an understanding of ecotoxicity against certain environmental conditions.

TH143 Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments

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explained by their overwintering or ageing. In contrast to insecticides, tebuconazol
insecticides, but the spring
respectively. However, the toxicity of both insecticides was almost identical
respectively, and for Sherpa − 0.556 (CI 0.453
RFD respectively. In terms of recommended field dose (R
individuals) and exposed individually to a single pesticide spray applied with the
spring (after overwintering) or autumn (population dominated by newly emerged
beetles). In this study, the toxicity of tebuconazol (TEB), were tested for their effects on survival of the ground beetle
Jagiellonian University; A. Bednarska, Polish Academy of Sciences / Institute of
Electrochemical control treatment. This is a three year study which began in
March 2017 with the drilling of the sugar beet seed at two different seed treatment
rates equivalent to a typical sugar beet seed loading and oil seed rape seed loading
natural fauna of the study area. The aim was to determine the impact of Thiamethoxam
on the full fauna of naturally occurring non-target arthropods (NTA), including the ground beetles (Carabidae), which are natural pests
enemies in agricultural areas. Due to the growing demand for food, it is not possible
at the moment to stop using pesticides. We need, therefore, to make every effort
to ensure that they are used in a way that do not jeopardize NTA. In the present study,
three commonly used pesticide formulations: Durban 480 EC, containing the
organophosphate pesticide chlorpyrifos (CPF), Sherpa 100 EC, containing the
carbamate insecticide chlorpyriphos (CPF), and Dursban 10 EC, containing the
diazinon. In this study NTA populations will be monitored for a three year period that covers at least two
generations to enable the detection of any trans
generational effects that might
cause significant increase in survival at higher doses, possibly due to its
interference with immune competence of insects or elimination of pathogenic
fungi. The results show that at least some insecticide formulations may cause
unacceptable effects on NTA when applied according to recommendations,
indicating the urgent need for revising current pesticide usage recommendations.
The differences in sensitivity between the spring and autumn-collected beetles call
for further studies to see whether such seasonal differences can be important for
ERA. This study was supported by National Science Centre, Poland (2015/19/B/NZS/01939)

TH146

The fate and bioavailability of currently used and emerging pesticides in agriculturally used fluvios - effects of soil and pest generation

M. Šudoma, N. Neuwirthová, Masaryk University; M. Svobodová, Masaryk University / Research Centre for Toxic Compounds in the Environment
(RECETOX); L. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Hvezdova, Z. Simek, L. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment
(RECETOX); K. Brandštädt-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

The class of conazole fungicides (CFs), among them epoxiconazole, tebuconazole, flusilazole and prochloraz are currently used pesticides and members of the triazole group, used as broad-spectrum fungicides that inhibit ergosterol biosynthesis and are typically applied as foliar sprays for cereals, sugar beet or oilseed rape. Conazole fungicides are widely used in EU countries and their residues are frequently found in European arable soils which corresponds to their environmental properties. CFs are strongly sorbed to soil (logKoc of 3–4) and have low to moderate water solubility (54 mL/g). They are very persistent in soils and tend to form long-term resistant residues. In the present study, it is shown that these measurements will enable to test whether Cu and Zn availability in unplanted soils determined Cu and Zn phytoavailability or whether root-induced chemical changes in the rhizosphere additionally determined it.

TH145

Toxic Effects of Cadmium on Chinese Cabbage, Folsomia Candida (collembola) and their Prediction Modes in 18 Soils of China

L. Zheng, Y. Feng, Y. Zhou, Nanjing Institute of Environmental Sciences

In this paper, we adopted 18 Kinds of typical soils in China, and Chinese cabbage ,folsomia candida(collembola) were used as the research objects. The germination and root elongation of cabbage under different concentration of cadmium in soil were measured. The endpoint of the F. candida was reproduction. The results show that the soil properties significantly affected the dose effect curve of cadmium, soil pH is the main influencing factor; at the same time, we calculated the toxicity threshold and prediction models. This study has a guiding significance for the plant and invertebrates ecological risk prediction and assessment of heavy metal cadmium.
arthropod (NTA) populations, (2) the range of NTA taxa affected by the treatment and (3) the duration of treatment effects and the time period until populations recover. The evaluation will be based on (1) time to recovery (population density similar to control) and (2) persistence of effect (population growth similar to the control). Effects will be classified in accordance with De Jong et al. 2010.

TH148 Bioaccumulation kinetics of pesticides chlorpyrifos and tebuconazole in the earthworm Eisenia andrei in two different soils M. Svobodová, Masaryk University RECETOX; K. Smidova, Masaryk University RECETOX / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX This study was conducted to investigate the bioaccumulation of two pesticides currently used in large amounts in the agriculture, the insecticide chlorpyrifos and the fungicide tebuconazole. The two compounds have distinct properties suggesting their different fate in the soil and bioaccumulation. Their detailed uptake kinetics in the model earthworm species Eisenia andrei were measured to find a sufficient length of exposure to achieve equilibrium in concentration between soil and earthworm and to compare two pesticides in two arable soils differing in the organic carbon (1.02 and 1.93% respectively) and clay content (10.7 and 20.7% respectively). Concentrations of the pesticides in soils and earthworms were determined by LC-MS/MS after QuEChERS extraction which has shown to be rapid, simple and effective approach to determine broad spectrum of pesticides in soil and earthworm samples. According to our results, a steady state was reached after 3 to 5 days for both pesticides and soils. The values of bioaccumulation factors calculated at the steady state ranged from 4.5-6.3 for chlorpyrifos and 2.2-13.1 for tebuconazole. Bioaccumulation factors were also calculated as the ratio of uptake and elimination constants with results comparable with steady-state bioaccumulation factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also probably contributed, namely to degradation of chlorpyrifos by clay-catalysed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydrophobicity of tebuconazole relative to chlorpyrifos probably led to higher availability of tebuconazole through pore water exposure. On the other hand, higher hydrophobicity of chlorpyrifos probably caused an increase in availability by its additional uptake via ingestion.

TH149 Effects of diuron and imidacloprid on eight nematode species J.N. Neury-Ormann, Irstea / EABX-CARMA; C.N. Doose, INRS - Centre Eau Terre Environnement; N. Majdi, Ecolab / UMR 5245 CNRS; J. Vedrenne, S. Morin, Irstea Bordeaux / UR EABX; S. Hôss, Ecosa / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology To assess the ecotoxicological potential of the herbicides diuron (herbicide) and imidacloprid (insecticide) on ubiquitous organisms at the basis of food webs, we performed multispecies toxicity tests using nematode species commonly found in soil and freshwater benthic ecosystems. Diuron and imidacloprid belong to the top 15 of the most frequently detected pesticides in French rivers. Both chemicals show an elevated DT50 (time to 50% degradation) in sediments, about 130 days for imidacloprid and more than 300 days for diuron. The acute toxicity constants with results comparable with steady-state bioaccumulation factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also probably contributed, namely to degradation of chlorpyrifos by clay-catalysed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydrophobicity of tebuconazole relative to chlorpyrifos probably led to higher availability of tebuconazole through pore water exposure. On the other hand, higher hydrophobicity of chlorpyrifos probably caused an increase in availability by its additional uptake via ingestion.

TH150 Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida M. Quan, O. Zhang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (BDE47) on the springtail Folsomia candida were evaluated. Multigeneration tests were performed in accordance to two different test methods. In the first method, the parental generation springtails (F0) were exposed to PCP or BDE47 for 28 days. The first filial generation (F1) springtails were transferred to unpolluted artificial soil for 28 days and reproduced the second filial generation (F2). In the second method, the F0 generation were exposed for 10 days and then transferred to unpolluted artificial soil to generate the F1 generation. The F1 generation were also transferred to unpolluted artificial soil for 28 days and reproduced the F2 generation. For PCP, significant effects were observed on F1 and F2 generation in the first method and F1 generation in the second method. This suggests that PCP influences the reproductive capacity of adult springtails and the hatching of eggs or the mortality of juveniles. For BDE47, significant effects were only observed on F1 generation in the first method, which shows that BDE47 affects egg hatching through the reproductive capacity of adults. The affected endpoints of springtails can be inferred by the two methods. PCP and BDE47 do not influence completely the same endpoints.

TH151 Bioaccumulation of lead in earthworms: a comprehensive study to derive a bioaccumulation soil accumulation factor (BSAF) for risk assessment K. Oorts, ARCHE; J. Chowdhury, International Lead Association / Senior Scientist -Environment Secondary poisoning to mammals and birds is a critical pathway for risk assessment of Pb in soil. This risk is generally assessed for the food-chain soil => earthworms => earthworm eating predators. Therefore, a correct evaluation of bioaccumulation of Pb in earthworms is essential for risk assessment of Pb in soils under the REACH Regulation and a literature review of biota-to-soil accumulation factors (BSAF) for Pb in earthworm species was made. To ensure that biota Pb burdens are in equilibrium with soil Pb concentrations, only data from field studies or laboratory studies using soil and biota collected at the same field site were considered. Data from laboratory studies where Pb was added to the soil as a Pb salt were only used as supporting evidence. In total, 248 BSAF values for earthworms were identified that meet the reliability criteria, ranging from 0.01 to 22.05 (dry weight basis, median 0.23). Results are available for several earthworm species, belonging to different ecological groups of earthworms: anecic, endogeic and epigeic earthworms. No distinct differences in BSAF values across these groups could be identified. BSAF values are derived in a wide range of soils and the data the available can be considered as representative for soils in Europe. The overall cation exchange capacity (CEC) is significantly correlated with BSAF values. No significant correlation with Pb content, pH, organic carbon content or clay content is observed. The significant negative regression between log BSAF and log CEC was confirmed by laboratory studies and is also consistent with the significant decrease in Pb toxicity observed for Eisenia fetida reproduction with increasing CEC of the soil. It was concluded to implement the effect of soil properties on BSAF by using the overall regression between log CEC and log BSAF in the risk assessment of Pb in soil. This yields a generic BSAF of 0.30 on dry weight basis, corresponding to 0.048 on a fresh weight basis, for the median eCEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.028 for soils with an eCEC of 1 and 30 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of eCEC in European arable soils. Implementing effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.

TH152 Hazard assessment of liquid organic hydrogen carriers in terrestrial environment Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry; S. Markiewicz, University of Bremen / Centre for Environmental Research and Sustainable Technology; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry A proactive environmental hazard assessment of liquid organic hydrogen carriers (LOHCs) – a novel energy system which can efficiently and relatively safely store and transport hydrogen – was conducted by characterisation of potential behaviours and ecotoxicities of these chemicals in soil environment. Adsorption properties of promising LOHC candidates including indoles, quinaldines, carbazole derivatives, benzyltoluenes and dibenzyltoluene in terms of carbon-water partition coefficients (Koc) were investigated via HPLC screening. Further characterisation was performed via adsorption isotherm modeling and soil column leaching with the extraction of soil-water weight containing the following indoles/quinolines and carbazoles: 4,6-dimethoxy-2,3,5-trimethyl-2H-pyran-2-one (Quin-2MeMe)/8) in soils. The H2-rich form (Quin-2Me-H10) appeared the highest leaching capacity through the soil followed by the H2-leaen form (Quin-2Me) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H10 to soils given its high protonation at the soil pH; while hydrophobicity was the main force in the adsorption of its two analogues. No or only slight toxicity was found for the quinaldines in the soil bacterium Arthrobacter globiformis and Collembola Folsomia candida in pore-water and soil exposure scenarios. The log Koc values generally increased following indoles < quinaldines < carbazole derivatives < benzyltoluenes < dibenzyltoluene. The mobility of LOHCs was thus classified as highly mobile, moderately mobile or immobile. Adsorption isotherm and column leaching showed the strongest adsorption and retention of the partially hydrogenated form (Quin-2Me-ph) in soils. The H2-rich form (Quin-2Me-H10) appeared the highest leaching capacity through the soil followed by the H2-leaen form (Quin-2Me) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H10 to soils given its high protonation at the soil pH; while hydrophobicity was the main force in the adsorption of its two analogues. No or only slight toxicity was found for the quinaldines in the Arthrobacter at the highest test concentrations (500 mg L-1 and 750 mg kg-1 dry weight (dw) soil). Higher toxicity was found in the Collembola and malfornations.
of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10 < LC_{50} < 100 mg L^{-1} (liquid-only exposure) and 100 < EC_{50} < 1000 mg kg^{-1} dw soil (calculated soil pore-water based) of the quinazolines assigning these chemicals to category “harmful” to soil organisms. Predicted no-effect concentrations showed 1–3 orders of magnitude higher the effective concentrations than the former suggesting potential risks of the chemicals toward the soil environment and proper monitoring is needed in the application of the LOHCs. Key words: adsorption, bioavailability, hazard assessment

TH153
Combining field measurements and biotest to assess lead and zinc phytoavailability in contaminated urban soils
M. Burein, C. Chevassus-Rosset, CIRAD; L. Lemal, MetRHZlab; M. Montes, G. Moussard, E. Simon, M. Tella, CIRAD; M. Valmiyer, MetRHZlab; E. Doelsch, CIRAD / UPR Recyclage et risque; F. Feder, CIRAD; S. Legros, CIRAD / LITEN

Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to proof the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. Due to the lack of adequate plant biotest at the time the guideline was published (i.e. in 2005), the guideline suggests to measure trace element phytoavailability in the aerial parts of plants collected in situ in contaminated and uncontaminated soils. The present study aimed at applying the guideline methodology with the combination of a recently developed plant biotest (i.e. the RHIZOtest) and field measurements to lead (Pb) and zinc (Zn) contaminated urban soils on which irrigation with treated wastewater was foreseen. Ten contaminated and uncontaminated soil samples (hereafter referred to as soil) were collected in representative sites expected to be irrigated with treated wastewater. The phytoavailability of Pb and Zn was estimated on each soil by measuring Pb and Zn concentration in the aerial parts of field-collected plants and by deploying the RHIZOtest and measuring the uptake flux of Pb and Zn in the whole plants exposed to Pb-contaminated soils. As expected, field-collected plants exhibited a large range of Pb and Zn concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.

TH154
Can approaches beyond the traditional ones characterize the effects on soil microflora provide an added value in the scope of regulation?

According to the EU legislation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EFSA a more comprehensive risk assessment is required. We investigated whether a combination of several test approaches addressing various microbial aspects results in a better understanding of the fluctuation of the soil microflora after a threat and a more comprehensive risk assessment taking the new requirements into consideration ecosystem services and the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the functional diversity; (ii) respiration activity of the heterotrophic microflora as indicator for the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the functional diversity; (ii) respiration activity of the heterotrophic microflora as indicator for the protection of the biodiversity into account. The determination of the tested concentration at regular intervals is currently not implemented as well as the statistical power of test is not properly evaluated. In a project published by Christl et al. (2016), results from standard laboratory earthworm reproduction tests are compared with the effect levels in higher tier studie for a representative active of the EU (Field studies) under more realistic conditions may be one option. Standardised field protocols are mainly available for earthworms. The available standardised field methods evaluate the effects on abundance and biodiversity of earthworms, taking into consideration the likely level of effects, the species/groups affected, population recovery (within 1 year) as well as information on the application and fate of the pesticide. The magnitude of effects is directly assessed in terms of risk without the application of any assessment factor. However, field studies only give a picture of a particular situation as effect manifestation and recovery are dynamic processes which depend on the local situation and time-scale. Additionally, an assessment at community level which takes into account interspecies interactions and indirect effects is currently not implemented as well as the statistical power of test is not properly evaluated. An approach aimed at defining a Regulatory Acceptable Concentration (RAC) could be useful to address those uncertainties and would allow the harmonisation of the risk assessment of the different taxonomic groups.

TH157
SETAC Soils Interest Group
M.H. Wagelmans, Bioclear earth

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (P)

Re-calibration of the earthworm Tier 1 risk assessment of plant protection products - an update
G. Frist, Bayer Ag / Ecotoxicology; J. Bendall, Dow Agrosciences; T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsafis, ADAMA; S. Lousteti, DuPont De Nemours Hellas S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O'Neill, DuPont Crop Protection; A. Sharps, FMG Agricultural Solutions; F. Staab, BASF SE

This presentation in tier 1 assessment of plant protection products (PPP) is expected to increase due to revision of the PEC_{soil}modelling guidance. The new EFSA guidance foresees to use worst case PEC_{soil} values for each European regulatory zone considering a lower soil bulk density, a lower organic carbon content, and a reduced crop interception rate due to consideration of worst case wash-off assumptions. Furthermore, several different soil layers for which PEC_{soil} values could be calculated are under discussion, i.e. 0-1 cm, 0-2.5 cm, 0-5 cm, and 0-20 cm soil depth. Calculated PEC_{soil} values based on the new EFSA guidance are estimated to strongly increase, which might lead to an overly conservative tier 1 risk assessment. In a project published by Christl et al. (2016), results from standard laboratory earthworm reproduction tests are compared with the effect levels in higher tier studies for a representative active of the EU (Field studies) under more realistic conditions may be one option. Standardised field protocols are mainly available for earthworms. The available standardised field methods evaluate the effects on abundance and biodiversity of earthworms, taking into consideration the likely level of effects, the species/groups affected, population recovery (within 1 year) as well as information on the application and fate of the pesticide. The magnitude of effects is directly assessed in terms of risk without the application of any assessment factor. However, field studies only give a picture of a particular situation as effect manifestation and recovery are dynamic processes which depend on the local situation and time-scale. Additionally, an assessment at community level which takes into account interspecies interactions and indirect effects is currently not implemented as well as the statistical power of test is not properly evaluated. An approach aimed at defining a Regulatory Acceptable Concentration (RAC) could be useful to address those uncertainties and would allow the harmonisation of the risk assessment of the different taxonomic groups.

TH156
Digging into the soil risk assessment of pesticides: current approach and its uncertainty
M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Auteri, s.barmaz, EFSA - European Food Safety Authority / Pesticides Unit; S. Peiper, Ministry for Federal Environment, Nature Protection and Consumer Protection (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit / BMU)en according to the Uniform Principles (Reg No 546/2011) in the context of Regulation (EC) No 1107/2009, all possible sources of uncertainties should be considered when performing a regulatory assessment in the context of pesticides authorization. The current risk assessment for soil organisms, conducted according to SANCO/10329/2002, foresee, at Tier 1, the application of a trigger value of 5 to govern the lower tier to account for intra- and interspecies variability and the extrapolation of toxicity endpoints from lab- to field. However, the current approach presents additional uncertainties. Test methodology for soil organisms only requires dosing verification after the application of the pesticide to the soil. The determination of the tested concentration at regular intervals is currently not required although it may be very relevant for a proper hazard characterization (e.g. bioavailability), since, for example, during laboratory bioassay procedures of spiked soils, possible losses of the pesticide may occur. In case further refinements of the risk are triggered, higher tier tests (semi-field or field studies) under more realistic conditions may be one option. Standardised field protocols are mainly available for earthworms. The available standardised field methods evaluate the effects on abundance and biodiversity of earthworms, taking into consideration the likely level of effects, the species/groups affected, population recovery (within 1 year) as well as information on the application and fate of the pesticide. The magnitude of effects is directly assessed in terms of risk without the application of any assessment factor. However, field studies only give a picture of a particular situation as effect manifestation and recovery are dynamic processes which depend on the local situation and time-scale. Additionally, an assessment at community level which takes into account interspecies interactions and indirect effects is currently not implemented as well as the statistical power of test is not properly evaluated. An approach aimed at defining a Regulatory Acceptable Concentration (RAC) could be useful to address those uncertainties and would allow the harmonisation of the risk assessment of the different taxonomic groups.
A novel analytical method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives was developed. This method is based on optimization of SPME factors, including extraction temperature, sampling time and fiber coating. The study used a combination of statistical techniques, including factorial designs, to determine the optimal conditions. The method was validated using real water samples, and the results showed good accuracy and precision. The method can be used for the detection and quantification of ptaquiloside-like compounds in water samples, which is important for risk assessment and management.

Harmful algal bloom smart device application: using image analysis and machine learning techniques for classification of harmful algal blooms. This project focuses on developing a smart device that can be used to detect harmful algal blooms using image analysis and machine learning techniques. The device is designed to be used in real-time to monitor algal blooms in aquatic environments, such as lakes and reservoirs. The project involves collaboration with experts in image analysis, machine learning, and algal biology. The project aims to develop a portable and cost-effective device that can be used by water managers and other stakeholders to detect harmful algal blooms early and take appropriate actions to prevent environmental and health impacts.

Matrix-assisted laser desorption/ionization-time of flight mass spectrometry application for rapid screening of microcystins occurrence in northern Taiwan tap-water reservoirs. This project focuses on the development of a rapid screening method for the detection of microcystins, which are harmful algal bloom toxins. The method is based on matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF-MS) and is designed to be used in real-time for water quality monitoring in northern Taiwan reservoirs. The project involves collaboration with experts in mass spectrometry, environmental science, and water quality management. The project aims to develop a cost-effective and rapid method for the detection of microcystins in water samples, which can be used by water utilities and other stakeholders to prevent health and environmental impacts.

Smelly HABs: response-surface optimized HS-SPE-GC/MS method for detecting multi-class HAB odor compounds in water. This project focuses on the development of a method for the detection of multi-class harmful algal bloom (HAB) odor compounds in water samples. The method is based on response-surface optimization of high-speed solid-phase extraction (HS-SPE) and gas chromatography/mass spectrometry (GC/MS). The project involves collaboration with experts in analytical chemistry, environmental science, and water quality management. The project aims to develop a cost-effective and rapid method for the detection of multi-class HAB odor compounds in water samples, which can be used by water utilities and other stakeholders to prevent health and environmental impacts.
Cyanobacteria are one of the components of aquatic microorganisms in pelagic and benthic ecosystems. The community distribution is affected by water quality, flow regime, climate, and geology. During the past decades, there has been a noticeable increase in cyanobacterial blooms, dominating in many freshwater bodies worldwide. Some cyanobacteria species are known to produce toxic secondary metabolites called cyanotoxins, which vary in structure and harmful properties (hepatotoxins, neurotoxins), and being a major concern for drinking water supply and recreational water use. The most widespread cyanotoxins are microcystins (MCs) variants MC-LR, -RR, -YR, with MC-LR being the most toxic one. For this reason, the World Health Organization appointed a guideline of 1 μg/L in drinking water for total MC-LR. In order to monitor levels of cyanotoxins and prevent both human poisoning and wildlife damage, suitable analytical methods need to be developed. This work presents the development of a sensitive, fast and highly robust method for analysis and identification of harmful cyanobacterial cells in surface waters by high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample treatment of cyanotoxins, solid-phase extraction for multiple toxins has been employed, which was recently developed in our research group. The chromatographic separation was achieved using a C18 analytical column (150x2.1 mm, 5μm) using methanol and water as mobile phase. The total chromatographic run was 15 min. The chromatographic separation was coupled to a Q-Exactive Orbitrap instrument (Thermo Fisher Scientific). The interphase used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the potential presence of transformation products and other non-targeted toxins in the samples. This multi-toxin method has been developed and validated for freshwater cyanobacteria such as microcystins, nodularins, cylindrospermopsin, and anatoxin-a. The developed method was applied for the study and characterization of cyanotoxins concentrations in Catalonia freshwater reservoirs. Keywords: cyanotoxins, microcystins, high-resolution mass spectrometry.


TH165 Adequacy of EPI Suite prediction models to estimate physicochemical properties of natural toxins potentially present in surface water. J. Rodríguez Leal, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES, M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry Natural toxins constitute a potential risk to water supplies in Europe. Only a few attempts have been made to assess natural toxins in water according to their persistence and potential degradation rate constants in the aquatic environment that have been determined by experimental methods or estimated using quantitative structure-activity relationship (QSAR) and quantitative structure-property relationship ( QSPR) models. QSAR predictions should be considered carefully when applied to a set of chemicals that are structurally distinct from those that were used to develop the model. The establishment of an applicability domain of the models provides a range of chemicals where the predictions are expected to be reliable and based on extrapolation rather than extrapolation, regarding the structure of the chemicals in the training set (Gramatica 2007). We present here an analysis of the applicability domain of selected EPI Suite™ QSAR models, and interpret the results with reference to natural toxins within these limits that could be included in a systematic prioritization of natural toxins in wastewater according to their persistence and mobility. References Bucheli, Thomas D. 2014. “Phytoxins: Environmental Micropollutants of Concern?” Environmental Science & Technology 44 (22): 13027–33. Gramatica, Paola. 2007. “Principles of QSAR Models Validation: Internal and External.” QSAR & Combinatorial Science 26 (5):694–701. US EPA. 2017. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.

TH166 Cyanobacterial oligopeptides of environmental concern and (co)production dynamics. R. Sanches Natumi, E. Vonwyl, Eawag Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry, E. M. Janssen, Eawag Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry Our ecosystems and drinking water resources are not only vulnerable towards anthropogenic pollutants. Natural toxins present an additional threat for which we still lack a comprehensive overview. Cyanobacteria produce a wide range of natural toxins from various kingdoms, those produced by aquatic organisms have a direct entry into our water resources. More frequent and intense surface water blooms of cyanobacteria have triggered particular scientific interest in their secondary metabolites as potential aquatic toxins. The variety of cyanopeptides is well documented since the 1990s and the growing publication record reflects an increasing scientific awareness. Cyanopeptides can be divided in six structural classes characterized by indicative monomeric building blocks. Microcystins are by far the most intensively studied class of cyanopeptides. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides beyond microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides under different culturing condition of common cyanobacterial strains. Our targeted LC-HRMS analysis of biomass samples of single strain cultures show that besides microcystins, cyclamides and various cyanopeptolins are co-produced. Our data shows the evolution of the...
peptide abundance throughout the growth phase of single strains (e.g., Microcystis aeruginosa and Anabaena flos-aquae) and under different culturing conditions (e.g., N:P ratios and light intensities) by multifactoral analysis. New insights into co-production dynamics offer critical information about cyanotoxin mixtures present during harmful algae blooms and with that critical knowledge towards comprehensive risk assessment.

TH167 Degradation of the carcinogenic paquioquiadiol under alkaline conditions

D. Lindequist, L. Rasmussen, Metropolitan University College

The carcinogenic paquioquiadiol (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus Pteridium (Bracken ferns), with P. aquilinum PT-A and PT-B as parts of the fern. PTA is suspected of causing Human gastric cancer. PTA is a non-sesquiterpene glycoside and is not sorbed by soils to a great extent (logKow of approx. -0.5). Hence, PTA can leach from Bracken stands. Leaching is most prominent during rain but baseline levels are found in streams in Bracken infested areas. Soil contamination and consumption of upper aquifers has been observed on a number of occasions. PTA may contaminate groundwater resources. Dissipation of PTA under environmental conditions is governed by a number of factors: Enzymatic activity; pH (hydrolysis); irreversible sorption/reactions; and sorption to clay minerals. Bacterial activity and hydrolysis are the most important mechanisms causing dissipation of PTA. The purpose of this study was to describe the underlying mechanisms for the hydrolysis of PTA and formation of reaction products under near-sterile alkaline conditions as found in calcareous aerobes. PTA (4,700ppb) was deglycosylated using 0.010/10/1.0 M NaOH and 3 different 0.025M buffer systems (approx. pH 7–12, NaHCO3/Na2HCO3/pH regulated with 0.1M NaOH). Dissipation of PTA and formation of reaction products were monitored up to 200hrs at 25°C. PTA and the main reaction product pterosin B (PTB) was quantified by LC-MS using SIM- and TIC-modes. Formation of other reaction products was analysed semi-quantitatively using the relative area distribution of the main mass traces. Chemical rate constants are reported for degradation of PTA and species formation. Dissipation of PTA were pH dependent as previously observed. Addition of 0.01-1.0M NaOH results in immediate degradate of PTA and formation of a small amount of PTB plus two more reaction products. The concentration of PTB remained constant over time. PTB is the endproduct of hydrolysis in pure solutions. One reaction products was identified as the bracken dienone (BDE), a ultimate carcinogenic. BDE is formed immediately while the unknown is formed from BDE reaching stoichiometric balance within the timeframe of the experiments. Rate of formation were dependent on pH, as well as of the buffer system used. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

TH168 Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins

C.D. Schoonees, Agroscope / Environmental Analytics; K. McNeill, ETH Zurich / Institute of Ecological Chemistry and Pollutant Dynamics; T. Bucheli, Agroscope ART / Environmental Analytics

The octanol-water partitioning coefficient (Kow) remains one of the key parameters in environmental fate and risk assessment of organic chemicals for regulatory purposes.[1] Based on predicted Kow values, many natural toxins are expected to be mobile in the aquatic environment. If such toxins are not retained well in soils, they may easily move through the soil profile. In order to test such assumptions as natural toxins, with physicochemical and structural complexity due to large numbers of various functional groups, current estimation models for Kow and other phase distribution parameters fail. One approach was identified as the bracken dienone (BDE), a ultimate carcinogenic. BDE is formed immediately while the unknown is formed from BDE reaching stoichiometric balance within the timeframe of the experiments. Rate of formation were dependent on pH, as well as of the buffer system used. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

TH169 Phytotoxins as aquatic micropollutants: a procedure for prioritization

B.F. Guennhard, Agroscope / Environmental Analytics; J. Hollender, Eawag / Environmental Chemistry; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; K. Hungerer, T. Zarti, Department of Chemical and Biochemical Engineering; T. Bucheli, Agroscope ART / Environmental Analytics

Phytotoxins are natural toxins produced by plants with widely varying molecular structures and toxic effects. Despite possibly high concentrations of natural toxins in vegetation, crops and freshwater, they are not yet commonly perceived as environmental contaminants of possible concern. This far, environmental exposure and effect studies have only been conducted for a very limited number of phytotoxins, and systematic and larger monitoring campaigns are completely lacking. A crucial challenge is to systematically identify among the plethora of phytotoxins those that actually present a serious risk for the aquatic environment.

For this purpose, we ranked 1586 phytotoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytotoxins. Toxicity was included as descriptor of the effect and parametrized by both plant, and estimated compound toxicity. Plant frequency, obtained from InfoFlora, was used to estimate the occurrence of all plant species producing a certain secondary metabolite class and serves as an approximation of exposure. To identify the phytotoxins relevant for the aquatic environment we used a procedure, which systematically ranks substances suspected of causing human gastric cancer. Pterosin B is formed from paquioquiadiol upon hydrolysis. Similar pterosins are formed from caudatoside and ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from paquioquiadiol. Pterosin B is not toxic, but is interesting as the compound can be used to assess previous presence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC %: 0.1-7.4, pH 3.3-7.3). 0.25g of dry soil were equilibrated with 9ml 0.01M CaCl2 over-night. 1ml of pterosin B solution in 0.01M CaCl2 was added resulting in a CaCl2 of 0-10 mg L⁻¹ (n=5-20). Sorption were studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI (SIM; 100µL injections; range 0-100 µg L⁻¹; r² ≥ 0.999). ClogKow were calculated as ClogKow = Ctot / Caq. Irreversible sorption and microbial degradation was applied to assess the reaction based on previous studies. Pterosin B sorb strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKow of 3.3. Kd ranged between 70 and 180 mL g⁻¹ for the soils tested corresponding to a Koc values of 300-2,500 mL g⁻¹. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic material. As Koc values can vary substantially, depending on soil type and properties like mineral content and organic matter variation were expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of paquioquiadiol.

TH170 Sorption of pterosin B to soil materials

J. Andersen, L. Rasmussen, Metropolitan University College

Bracken ferns (Pteridium sp.) are considered environmentally problematic due to their content of the carcinogens paquioquiadiol, caudatoside and ptesculentoside (‘the paquioquiadiol group’). Brackens are classified by WHO/IANC in Group 2B due their carcinogenic properties at cellular level and due to their association with several veterinary diseases. Brackens cause bovine urinary bladder cancers and are suspected of causing human gastric cancer. Pterosin B is formed from paquioquiadiol upon hydrolysis. Similar pterosins are formed from caudatoside and ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from paquioquiadiol. Pterosin B is not toxic, but is interesting as the compound can be used to assess previous presence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC %: 0.1-7.4, pH 3.3-7.3). 0.25g of dry soil were equilibrated with 9ml 0.01M CaCl2 over-night. 1ml of pterosin B solution in 0.01M CaCl2 was added resulting in a CaCl2 of 0-10 mg L⁻¹ (n=5-20). Sorption were studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI (SIM; 100µL injections; range 0-100 µg L⁻¹; r² ≥ 0.999). ClogKow were calculated as ClogKow = Ctot / Caq. Irreversible sorption and microbial degradation was applied to assess the reaction based on previous studies. Pterosin B sorb strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKow of 3.3. Kd ranged between 70 and 180 mL g⁻¹ for the soils tested corresponding to a Koc values of 300-2,500 mL g⁻¹. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic material. As Koc values can vary substantially, depending on soil type and properties like mineral content and organic matter variation were expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of paquioquiadiol.
Natural toxins are gaining more interest in the scientific community as emerging pollutants. The reason behind is that they are released continuously to the environment and often in high amounts. The related risks to humans depend strongly on the physicochemical characteristics, load and fate of the natural toxins in the environment. The aim of this work is to develop a modelling approach to predict the fate and in particular the leaching of natural toxins in the vadose (soil) zone. For the work, the model code DAISY, a soil-water-atmosphere model, has been used. Modelling of natural toxin fate presents several challenges compared with xenobiotics: many and partly continuous sources, variable and poorly studied physicochemical properties of the toxins, highly variable temporal and spatial rates of transfer of the toxins from the source plant to soils, — often linked to specific events. This work focused on ptaquiloside (PTA), a hydrophilic and non-sorbing toxin that exhibits a strongly pH and temperature dependent degradation. The cariogenic toxin is produced by branched fern (Pteridium aquilinum) that usually forms dense stands. The PTA content in bracken is up to 9800 μg g⁻¹ dry matter. The modelling approach was to parameterize a bracken growth submodule in order to simulate biomass and canopy. Spraying was used as the method to apply the toxin to the canopy, similarly to pesticides as included in DAISY. It is assumed that the toxin is washed off from the canopy with precipitation. The model was improved with new functions to parameterize hydrolysis. Hydrolysis is pH and soil horizon dependent, while microbial degradation rates follow the guidelines by FOCUS:unMaximum PTA concentration in the leachate at a depth of 2 m were 2.5 and 1 μg l⁻¹ in a sandy loam and sandy soil, respectively. These could indicate that bracken is essential to the elucidation of original significance of these molecules for cyanobacteria. In the animal kingdom, biosynthetic apparatus for retinoids is essential to the elucidation of original significance of these molecules for cyanobacteria. In the animal kingdom, biosynthetic apparatus for retinoids is essential to the elucidation of original significance of these molecules for cyanobacteria. The most related apparatus of retinoids in animals are aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Our study has been inspired by biosynthetic machinery of these small "dietary" hormones in animals and provides an evolutionary comparison of all ALDH and CYP in publicly available genomes of cyanobacteria to well-characterized ALDH and CYP from human and mouse, which are involved in the biosynthesis of retinoids. This comprehensive phylogenetic study describes evolutionary similarity of cyanobacterial ALDH to human and mouse ALDH from family 1. This fact points out to a similar function of these enzymes in the biosynthetic machinery of retinoids. Based on these results, the most related cyanobacterial ALDHs (to human) were selected from different cyanobacterial genomes and heterologously expressed in direct cloning-proficient E. coli strain GB05-dir. Effectiveness of expression reflected as the amount of produced retinoids was assessed by in vitro bioassay on cell line P19/A15 with endogenous expression of retinoid receptors stably transfected with reporter luciferase gene under the control of retinoid response elements in the presence of retinoids. One-step rapid assay for all-trans retinoic acid was measured by LC-MS/MS. The project is supported by the Czech Science Foundation and National Sustainability Program of the Czech Ministry of Education, Youth and Sports (LO1214 and LM2015051).

Emerging treatment methods for the removal of cyanotoxins from drinking water with focus on Advanced Oxidation Processes

Cyanobacteria form blooms in freshwaters due to environmental pollution and can produce taste and odour compounds, but also substances that have been shown to be toxic to animals, humans and other organisms. Numerous events of cyanotoxin-associated poisonings of pets, livestock, birds, wildlife and humans, and in some cases even subsequent death, occurred — and still occur — globally. These mainly waterborne secondary metabolites can adversely affect the quality of water intended for drinking and recreational purposes. So far, most countries have not yet enforced strict regulations regarding maximum tolerable cyanotoxin levels in drinking water. Some countries adapted the WHO provisional guideline value of 1 μg/l for microcystin-LR or amended it for country-specific regulatory values. Due to their diversity, fluctuating environmental occurrence and concentration, conventional drinking water treatment can result in insufficient removal of cyanotoxins. Advanced Oxidation Processes (AOPs) are emerging treatment methods that have been shown to be very promising for the removal of organic pollutants in general, also providing a potential for the removal of cyanotoxins. AOPs promote the in situ formation of highly reactive radicals, mainly hydroxyl radicals (•OH), and other mechanisms. Hydroxyl radicals are non-selective and randomly attacking oxidants, usually reacting with rate constants orders of magnitude higher than for other oxidants. So far, most research focuses on treatment of microcystins, but other toxin classes such as nodularins, saxitoxins, cylindrospermopsin and anatoxins have also been shown to be susceptible to be removed by AOP treatment. The most often reported AOPs for the removal of cyanotoxins include ozonation, photo-oxidation, photocatalysis, direct and catalyst-enhanced photolysis, and hydrolysis. Hydrolysis is pH and soil horizon dependent, while microbial actions, mainly hydroxyl radicals, play a role in their synthesis from carotenoids. The enzymes aldehyde dehydrogenases (ALDH) and cytochromes (CYP) are involved in the synthesis and degradation of these toxins. It has been documented that cyanobacteria are potent producers of these molecules for cyanobacteria. In the animal kingdom, the biosynthetic machinery of these small "dietary" hormones is essential to the elucidation of original significance of these molecules for cyanobacteria. In the animal kingdom, the biosynthetic machinery of these small "dietary" hormones is essential to the elucidation of original significance of these molecules for cyanobacteria. In the animal kingdom, the biosynthetic machinery of these small "dietary" hormones is essential to the elucidation of original significance of these molecules for cyanobacteria. The most related apparatus of retinoids in animals are aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Our study has been inspired by biosynthetic machinery of these small "dietary" hormones in animals and provides an evolutionary comparison of all ALDH and CYP in publicly available genomes of cyanobacteria. One-step rapid assay for all-trans retinoic acid was measured by LC-MS/MS. The project is supported by the Czech Science Foundation and National Sustainability Program of the Czech Ministry of Education, Youth and Sports (LO1214 and LM2015051).
B1 (AFLI) and total aflatoxin (AFT), as a screening test, was used in order to analyze imported nuts, from non-European countries, intended for direct human consumption. The percentage of AFT positive samples (only pistachios and almonds), taken during the three years from 2013 to 2015, under the national programs of official control, amounted to 9% for B1 and 10.5% for AFT, and were confirmed by HPLC (High Performance Liquid Chromatography). The results demonstrate that AFT-1 is produced from Turkestan A. flavus and that ELISA is a sensitive screening method to monitoring residue levels. The aflatoxins levels in pistachios exceeded even more than five times the maximum permitted limits set by European Commission in Reg 16/2010 and referred to the edible part of the tree nuts. The higher incidence of AFTs in imported shelled pistachios is probably due mostly to an easier aflatoxin contamination following the fact that pistachios with intact cortex are more resistant to the A. flavus colonization. The paper should be of interest both for readers in the areas of hazard analysis for monitoring purpose, and for other researchers in mycotoxic field, due to the great utility of low-cost, rapid and reliable methods of analysis.

**TH176**

Impact of climate change drivers on toxin contamination and genotoxicity in *Mytilus galloprovincialis*: combined effects of warming, acidification and harmful algal blooms.

A.R. Braga, Biology Department CESAM, Aveiro University; C. Camacho, IPMA, IP.; V. Pereira, R. Marçal, A.M. Marques, Biology Department CESAM, Aveiro University; S. Guillerme, Biology Department CESAM, Aveiro University / Biossec, University of Brest; M. Pacheco, Biology Department CESAM, Aveiro University / Dept of Biology; P. Costa, IPMA, IP.

*Mytilus galloprovincialis* under current environmental conditions and at conditions simulating scenarios of climate change, namely warming, acidification and the combination of these two factors were exposed to paralytic shellfish poisoning (PSP) toxin-producing *Gymnodinium catenatum*. Shellfish toxicity derived from accumulation of algae toxins was assessed in mussels at the four treatments as well as the damage at DNA level via the comet assay. Mussels were acclimated for 21 days and then exposed to *G. catenatum*, during 5 days (uptake), followed by 10 days with non-toxic diet (elimination). The analyses of PSP toxins in the mussels were carried out by Liquid chromatography with Fluorescence detector (LC-FLD). The highest PSP content was observed at day 5 in mussels in the actual conditions (1493.8 ± 202.4 µg STXeq. kg⁻¹), which exceeded the international seafood safety limits (800 µg STXeq. kg⁻¹). Significantly lower PSP content was observed in mussels under climate change scenarios. The lowest levels (661.9 ± 22.8 µg STXeq.kg⁻¹) were found in warm-acclimated mussels, followed by acidification (761.2 ± 62.3 µg STXeq.kg⁻¹). However, interaction of both parameters did not reveal an additive effect. Lower toxin elimination was observed in warm-acclimated mussels. Genotoxicity was assessed in gills and hepatopancreas of mussels sampled at the end of each period. In mussels not exposed to toxic algae, the comet assay revealed highest damage levels in mussels under combined effects of warming and acidification at the end of the experiment (i.e after 36 days). When mussels were exposed to *G. catenatum*, DNA damage in both gills and hepaticopancreas significantly increased at an earlier stage, i.e just after the uptake period. The treatments representing the acidification scenario and the interaction warming with acidification revealed higher DNA damage than the actual conditions, highlighting a synergistic impact. DNA damage decreased in all treatments at the end of the elimination period, although reduction was subtle in mussels under interaction of warming and acidification. This is the first study assessing the impact of the combined effect of warming, acidification and biotoxins in shellfish. In conclusion, it was provided evidences that changes of global conditions may lead to lower PSP contents, but also to slower elimination rates and to a synergistic effect on DNA damage implying possible consequences for the mussels populations.

**TH177**

Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems.

E. Lance, University Reims Champagne Ardenne / Biology and Biochemistry; A. Lepoutre, UMR 02 INERIS-Urca-ULH SEBIO; Z. Anzil, IFREMER / Laboratoire Pharmacie Marine; M. Bormans, UMR CNRS Ecobio / UMR Ecobio; I. Blahova, University of Rennes 1 / UMR 6553 ECOBIO

The eutrophication of aquatic ecosystems, associated to climate change, enhance the frequency and the severity of cyanobacterial proliferations. Cyanobacteria are photosynthetic organisms producing endotoxins such as neurotoxins, hepatotoxins, dermatotoxins, and cytotoxins, threatening target organisms and humans. The interactions of cyanobacterial toxins and human health are complex, and the effects on organisms is overall quite well documented. However, the neurotoxin β-methylamino-L-alanine (BMAA), suspected to be a causative agent in the human neurodegenerative disease amyotrophic lateral sclerosis (SLA), is less studied. The bioaccumulation of BMAA has recently been demonstrated with highly selective analytical methods in various marine organisms (zooplankton, mussel, oyster, fish), but rarely in freshwater organisms. Bivalves are known to consume phytoplanktonic species such as cyanobacteria or diatoms, both known to produce BMAA, and can be used as sentinel organisms to reveal the environmental contamination. A dual approach, in the laboratory and in situ, is used to evaluate the pertinence of the bivalves *Anodonta anodonta, Dreissena polymorpha* and *Mytilus edulis* as bioindicators of the contamination of fresh and estuarine waters by MCs and BMAA. The laboratory approach consist in the evaluation of the kinetics of BMAA and MCs accumulation and detoxification in bivalves at various times and concentrations of exposure. The *in situ* approach consist in the evaluation of the MCs and BMAA accumulation in caged bivalves along a river continuum from with- and without freshwater systems, simulated in coastal areas used for mussel aquacultures. First results show MC and BMAA accumulation in laboratory-exposed *D. polymorpha* and *A. anodonta*, with varying kinetics. Freshwater and marine bivalves also accumulated MCs *in situ* and a MC transfer from fresh to estuarine waters occurred, highlighted by an accumulation in the marine bivalve *M. edulis*. The results of this project will facilitate the long-term tracking of the contamination of ecosystems by cyanotoxins, which will provide an advance in the knowledge about the ecodynamics of cyanotoxins and the main conditions of human exposure.

**TH178**

Tetrodotoxin: an Emerging Threat to Humans in the Mediterranean Area: First Detection in Italian Mussels

C.D. Dell’Aversano, University of Napoli Federico II, Department of Pharmacy / Pharmacy, L. Tartaglione, F. Varriale, University of Napoli Federico II / Department of Pharmacy; A. Penna, University of Urbino / Department of Biomolecular Sciences; M. Giacobbe, Institute for Coastal Marine Environment, CNR; S. Pigozzi, A. Milandri, Fondazione Centro Ricerche Marine; P. Bordin, L. Bili, Istituto Zooprofilattico delle Venezie; A. Turner, Plymouth University / Food Safety

Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (*Tetraodonidae*) [1]. Successively, TTX was isolated from other marine and terrestrial animals, as xanthid crab, trumpet shellfish, blue-ringed octopus, gastropods, starfish, and frogs. The wide distribution of TTX in genetically unrelated organisms has made TTX origin for long time controversial, with different kind of bacteria being identified as TTX-producing organisms [2]. Even *Alexandrium tamarense* – one of the paralytic shellfish poisoning toxins (PST) producing organisms – was proposed as potential biogenetic source of TTX [3]. Although fatal human poisonings following consumption of TTX-contaminated seafood have been described in Japan, in Italy, the accumulation of TTX in fish, oysters and mussels collected in Europe (Spain, Portugal, UK, Greece) has been recently reported. So, in the frame of a collaborative study on evaluation of PST-related risk in the Mediterranean area, mussels collected in the Siracusa bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophobic interaction liquid chromatography coupled with both high resolution and tandem mass spectrometry detection (HILIC-HRMS and HILIC-MS/MS). Both techniques highlighted the presence of high PST contamination levels, with samples collected in 2016 containing up to 10851 µg STX eq/kg. Unexpectedly, together with PST, tetrodotoxin was detected in Sicilian mussels. Although this was the first report of TTX in Italy, contamination levels found in mussels (0.8-6.4 µg/kg) were well below the regulatory limit of 2 mg TTX eq/kg established for TTX in Japan. Importantly, much higher contamination levels of TTX (413 µg/kg) have been detected in mussels collected in 2017 in the NE Adriatic coasts of Italy (Lagoon of Marano), in the frame of the monitoring programme for marine biotoxins regulated in the EU. [1] Wu Z, Xie L, Xia G, Zhang J, Nie Y, Hu J, Wang S, Zhang R. 2005. A new tetrodotoxin-producing actinomycete, *Norcardiopsis dassonvillei*, isolated from the oyster *Crassostrea gigas*. Appl. Microbiol. Biochem. 17:310-315. [2] Yasumura D, Yotsu M, Michishita T, Endo A, Kotak Y. 1986. Bacterial production of tetrodotoxin and anhydrotetrodotoxin. Agric. Biol. Chem. 50:793–795. [3] Kodama M, Sato S, Sakamoto S, Ogata T. 1996. Occurrence of tetrodotoxin in *Alexandrium tamarense*, a causative dinoflagellate of paralytic shellfish poisoning. Toxicon. 34:1101-1105.

**TH179**

The first report on neurotoxic anatoxin-a occurrence in cyanobacterial blooms in the Czech Republic

L. Bláhova, Research Centre for Toxic Compounds in the Environment (RECETOX) / A. Hlíšková, Charles University – Faculty of Science; RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; O. Lepová Skalčová, Faculty of Science, University of South Bohemia; L. Bláha, Masaryk University, Faculty of Science / Research centre for toxic compounds in the environment RECETOX

Protoctial cyanotoxins such as microcystins have been extensively studied all around the world but there is still a lack of research on the occurrence levels and risks of other toxic metabolites produced in harmful blooms of cyanobacteria. In this paper we present the results of the first survey focusing on lesser explored cyanotoxins, namely anatoxin-a, in the samples from the Czech Republic. Levels of cyanotoxins were analyzed in freeze-dried biomass collected during 2012-2015 in various reservoirs in the country. The focus was on blooms (total 34 samples) dominated by potential producers of anatoxin-a such as Dolichospermum sp. (syn. *Anabaena* sp.), *Aphanizomenon* sp. as well as blooms formed by less common cyanobacteria. The multi-target UPLC-MS/MS methodology was applied that allowed to analyze in parallel all major cyanobacterial toxins (microcystin-LR,
The aim of this study was to investigate the profiles of volatile and odorous compounds from cyanobacteria, which can degrade drinking water quality, making it unacceptable by consumers. In addition, volatile and odorous compounds from cyanobacteria can result in poor water quality and affect the environment. Therefore, T&O compounds are hazardous for tourism and recreational activities in lakes, as well as their transformation products. T&O are hazardous for tourism and recreational activities in lakes, and they can result in producing years of blooms. Based on the use of D5-labeled surrogate standards, especially for trimethylamine (fishy), dimethyl- and trimethyl-sulfide (septic), methanethiol (septic), b-cycloctatral (tobacco), a- and b-irones (floral). Interestingly, results showed that in surface water bodies of Greece geosmin and MIB have a minor role, while other T&O compounds having characteristic odor (e.g. fishy, swampy) may be more important. The use of the optimized methods, including several treatment techniques, i.e. protein precipitation using addition of salts and hexane extraction of lipids, were also tested in order to eliminate matrix effects and to maximize the recovery of the target compounds. Different SPE matrices were also tested in order to eliminate matrix interferences. The effect of matrix components after the selected pretreatment/clean up methods significantly improve the efficiency of the method. The diversity and affected method trueness. The use of the optimized methods, including several clean up methods, significantly improved the recoveries, reaching 85% for ANA-a and 12% for Microcystins (MCs), in freshwater fish tissues. For the efficient extraction of selected cyanotoxins from fish tissue and water reservoirs of Greece were collected for T&O analysis. The analysis of cyanotoxins in aquatic organisms, particularly in fish, has lately received increasing interest, due to environmental concerns and public health issues. This study presents the development and optimization of novel, sensitive and accurate analytical methods for the simultaneous determination of multi-class cyanotoxins, i.e. Cylindrospermopsin (CYN), Anatoxin-a (ANA-a) and nodularin, which in mid-September is the largest Italian island and is characterized by a dry hot climate. During the forty-sixties of the last century several water reservoirs have been built for drinking and irrigation water, and some of them have been interested by harmful cyanobacteria blooms. However, the monitoring programs have been discontinued, and no recent data are available for most of them. Therefore, a quarterly two years survey of main lakes used for drinking and irrigation water supply started in 2016, with a complete (chemical, physical, microbiological and microscopic) analysis of samples, according to the Italian D.Lgs. 152/2000, conducted to a water toxicity assessment through a Vibrio fischeri ecotoxicological test (ISO 11348:3-2007), Lake Dosiueri (37°11’26”N 14°17’16”E) was the only one in which a persistent bloom occurred during 2017 summer. After the July sampling when a Microcystis sp. bloom was first detected, the frequency of sampling was increased, to assess the risk of the exposed population and wild and domestic animals. Between mid-July and mid-September, the composition of the cyanobacterial community changed dramatically. In July the bloom was dominated by Microcystis sp. and Cylindrospermopsis raciborskii (in the order of 10^8 and 10^7 cell/L, respectively), the only two species detected. By mid-Aug these two species disappeared and have been substituted by Anabaenopsis sp. and Plankthotrix rubescens, which in mid-September were still growing (10^8 and 10^7 cell/L, respectively). Dosiueri Lake is among the largest lakes, with a surface of 1,850 km² and an average depth of 31 and 15.2 m, which indicates an important role, due to landfill and increasing and persistent dryness, depth can be reduced as much as to 1 m. Cyanobacteria are not always present (from Nov 2016 until Jul 2017 no species has been detected) and sediments represent probably the source for the inoula triggering the bloosms, as well as a sink-source for nutrients, in the agricultural area of the water catchment. Results on chemical (nutrients and cyanotoxins) and molecular analysis will be discussed with a risk-based approach, to determine the risk for health for the population and to plan future management strategies.
especially FAs have great structural diversity and high biological specificity, essential for every living cell, as sources of energy, as membrane constituents, or as metabolic and signaling mediators. FAs have long been used as food-web tracers, and, more recently, changes in FA profile have also been exploited to better understand how contaminants affect organisms in aquatic food-web (Silva et al. 2017). In this study, the potential impact of *A. armata* exudates in the FA profile of two marine invertebrates was assessed. First, after calculating the lethal concentrations of the alga exudate, *Gibbula umbilicalis* and *Palana serratus* were exposed for 168 hours to non-lethal concentrations of this exudate. Consequently, the trends in changes of FA abundance and composition were evaluated separately in the body tissue of the snails and in the shrimps hepatopancreas. Results showed different FA profiles between invertebrates but for both the studied species the profile was influenced by exudate concentration exposure, with significant alterations being observed for several saturated FA and polyunsaturated FA like Acid Arachidonic (ARA), EPA or DHA. These alterations can represent an impact on these organisms’ cell function since some of these FA have important communication and signaling roles within and between cells. Fatty acid profile showed to be a sensitive and highly informative parameter to address effects of marine exudates toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

**TH184**  
**Impacts of Asparagusopsis armata on marine invertebrates: behavioral and biochemical responses**  
C.O. Silva, Polytechnic Institute of Leiria; C.E. Silva, S.C. Novais, Polytechnic Institute of Leiria / MARE IPlLeiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPlLeiria.

The introduction of non-native seaweeds outside their native distributional range, through human activities, has been causing documented negative effect on native species. The red alga *Asparagusopsis armata*, with its invasive strategy including specialized cells capable of producing compounds with potent biological effects, is capable of inducing significant changes in terms of native community composition. This is specially occurring in rocky pools (intertidal zone) where *A. armata* releases several compounds that in these encosed and extreme conditions are often adverse for other organisms such as other seaweed, vertebrates, and invertebrates leading to severe consequences for coastal ecosystems. The main objective of this study was to evaluate the potential impact of *A. armata* on marine invertebrates by exposing the common prawn *Palaeon serratus* and the marine snail *Gibbula umbilicalis* to the exudate of this macroalgae. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20°C±1.

Affers of macroalgae exudates were observed and invertebrates were exposed to concentrations of the alga exudate, animals were exposed for 168 hours to non-lethal concentrations of this exudate and subsequently analyzed by biochemical biomarkers responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AchE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for *G. umbilicalis* and the avoidance behavior for *P. serratus*. The biomarker responses analysed on invertebrates showed an impairment of their physiological status after exposure to this algae exudate, with both species suffering from disruptions in their neuronal and energy metabolism functions, as well as from oxidative stress inducing damage in their macromolecules. Behavioural responses were also highly sensitive to *Asparagusopsis* exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of prospective effects of this macroalgae on the invaded ecosystems under a global change scenario.

**TH185**  
**Assessing consumption risks through cadmium-contaminated shellfish amplified by ocean acidification**  
D. West, Kobe University / Dept Biological Science and Environmental Biology; H. Lin, National Taiwan University; S. Chen, Chung Shan Medical University / Public Health.

The purpose of this study is to assess the human health risk of Taiwan population through consumption of cadmium-contaminated hard clam and oyster amplified by ocean acidification. This study employed forecasted ocean surface pH from the coupled model integrated in the project planned and projected emission scenarios representative concentration pathways 8.5, and Cd distribution as 0.001 – 2 µg L⁻¹ in Taiwan coast to estimate potential Cd accumulation of shellfish. A gender-specific physiologically-based pharmacokinetic model was developed to assess urinary and blood Cd concentration via daily shellfish consumption. The dose-response function was used to account for the prevalence of renal dysfunction and osteoporosis in response to human accumulated Cd in urine and blood. Results showed that median Cd accumulations under current and 2100 ocean acidification scenario were, respectively, 0.0009 and 0.0010 µg g⁻¹ for hard clam, whereas 0.0186 and 0.0210 µg g⁻¹ were estimated for the oyster. The urinary Cd concentration in female had potential 80% higher for ocean acidification scenario than that for non-ocean acidification. However, results revealed that exceedance risks of renal dysfunction and osteoporosis for gender-specific consumption only and whole groups under 2100 ocean acidification were no significant difference with that of current non-ocean acidification scenario. This study concluded that ocean acidification was not likely to increase synergistically the renal dysfunction and osteoporosis of human health risk through shellfish consumption.

**TH186**  
**Cyanobacterial toxins - a threat to the human respiratory tract?**  
B. Kubičková, Masaryk University, Faculty of Science; P. Laboha, Masaryk University / Research Centre for Toxic Compounds in the Environment RECETOX; J. Hildebrandt, Universität Greifswald / Animal Physiology and Biochemistry; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Babica, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX.

Intensified occurrence of toxic cyanobacterial blooms is becoming a major human health risk of Taiwan population biochemistry. Cyanotoxins in aerosols and exposure assessment. The research was supported by the Czech Science Foundation Grant No. G17-25279Y and from H2020-MSCA-ITN-2016 Project No.722493 NaToxAq.

**TH187**  
**Effects of microcystin-LR and cyanobacterial LPS in human airway in vitro models**  
O. Brzozan, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; B. Kubičková, P. Laboha, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Babica, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX; J. Hildebrandt, Universität Greifswald / Animal Physiology and Biochemistry.

Intensified occurrence of toxic cyanobacterial blooms is becoming a major human health threat. Microcystin-LR (MCLR) is probably the most frequent and abundant cyanotoxin detected in the environment, known to induce primarily hepatotoxic effects. Microcystin-LR is also known to induce inflammatory responses in alveoli and on lungs and respiratory system following both inhalational exposure as well as oral or intraperitoneal administration of the toxin. Therefore, we investigated effects of MCLR in human bronchial epithelial cell lines (HBE1, 16HBE14o, BEAS-2B). Cyanobacterial lipopolysaccharides (LPS) represent another bioactive component of cyanobacterial biomass, which is likely to expose human beings simultaneously with MCLR, thus we studied also effects of LPS isolated from a culture of cyanobacterium *Microcystis aeruginosa* PC677806. Dose- and time-dependent formation of MCLR-protein adducts was observed in the exposed human bronchial cells. Several genes from OATP family previously implicated in the cell uptake of MCLR were found to be expressed in HBE1 and/or 16HBE14o cells. Nevertheless, MCLR (up to 20 µM and 48 h) did not induce significant cytotoxic effects. MCLR targets protein phosphatases (PP1/PP2A), which are the major regulators of MAPKs ERK and p38. Although protein adducts with the molecular weight corresponding to MCLR-PP2A complex were detected, MCLR did not alter phosphorylation of MAPKs ERK1/2 and p38 in bronchial cell lines. Short
exposures to LPS (10 μg/mL) also did not significantly decrease cell viability and neither MCLR nor LPS affected gap junctional intercellular communication in bronchial cell lines. Regardless MCLR cell uptake, the toxin was relatively less cytotoxic to human bronchial epithelial cells when compared to the effects of other cyanotoxins (e.g. cylindrospermopsin), or in comparison with other cell types (e.g. hepatic or neural cells). Further experiments should focus on more detailed characterization of MCLR uptake and its long-term effects on MCLR and LPS on inflammation-related endpoints. Endoplasmic reticulum of other hepatocytes, cytochrome b561, and cytochrome b562 were also observed in different cyanobacterial blooms components and their complex mixtures, such as extracts and LPS isolated from different cyanobacterial strains and natural water blooms, should be also investigated in the future. The research was supported by the Czech Science Foundation Grant No. GJ17-23279Y and H2020-MSCA-ITN-2016 Project No.722493 NCtoxAq.

TH188 Estrogenic and retinoid-like activity in stagnant waters
S. Matuš, Masaryk University, Faculty of Science. RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; T. Procházková, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / Research centre for toxic compounds in the environment; J. Priebojová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX; E. Sychrová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment.

Estrogenic and retinoid-like activity in water were detected. Estrogenic activity was present in 11 out of 25 investigated water samples and the highest estrogenic activity (up to 256 ng REQ/L) was found in water samples collected during peak bloom conditions. Current results show that estrogenic activity is a persistent feature in cyanobacterial blooms components and their complex mixtures. Estrogenic activity could be observed in various cyanobacterial species, even in cultures in which estrogenic metabolites could be not detectable. Endocrine disruptive compounds could cause disturbance in hormone signalling and adverse effects in biota even at very low concentrations. Retinoids play a role as important signalling molecules which control vital cell processes like cell proliferation, development, reproduction or apoptosis. This study focused on freshwater ponds and reservoirs affected by cyanobacterial blooms and determined the estrogenic and retinoid-like activity of water by in vitro bioassay as well as concentrations of main estrogenic and retinoid compounds by LC-MS/MS analyses. Water samples from freshwater reservoirs and ponds with water blooms elicited estrogenic activity up to 2 ng REQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic compounds, alkylphenols or phytosterogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng REQ/L. We analysed the presence of nine retinoid substances, where 4-keto all trans retinoic acid and retinol were the most common forms detected in the samples. Retinoid-like activity was almost fully explained based on concentration and relative potency of individual analysed retinoids. However, current results also suggest that still other compounds with retinoid receptor-mediated modes of action are present. Our study highlights the ability of co-existant retinoids to exert different effects, which might be important for determining the toxic potential of cyanobacterial blooms in aquatic environment such as fish or amphibians. The SOLUTIONS Project is supported by the Seventh Framework Programme (FP7-ENV-2013) of the European Union under grant agreement no. 603437.

TH189 Excitatory effects of 2,4-diaminobutyric acid on leech Retzius nerve cell membrane potential. S. Spáňík, Faculty of Medicine, University of Belgrade / Institute for Pathophysiology; M. Stanojević, V. Nedičević, Faculty of Medicine, University of Belgrade / Institute for Pathophysiology Ljubodrag Buba Mihailović; M. Prostran, Faculty of Medicine, University of Belgrade / Institute for Pharmacology, Clinical Pharmacology and Toxicology; S. Lopičić, Faculty of Medicine, University of Belgrade / Institute for Pharmacology and Toxicology; K. Ilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX.

Cyanobacterial water blooms represent worldwide problem in many freshwater as well as marine ecosystems as producer of substantial amount of various bioactive compounds, some of which can cause adverse effects and pose risk to both aquatic organisms and humans. Recent investigations indicate that cyanobacterial metabolites could include compounds with estrogenic and/or retinoid-like activity. Endocrine disruptive compounds can cause disturbance in hormone signaling and adverse effects in biota even at very low concentrations. Retinoids play a role as important signalling molecules which control vital cell processes like cell proliferation, development, reproduction or apoptosis. This study focused on freshwater ponds and reservoirs affected by water blooms and determined the estrogenic and retinoid-like activity of water by in vitro bioassay as well as concentrations of main estrogenic and retinoid compounds by LC-MS/MS analyses. Water samples from freshwater reservoirs and ponds with water blooms elicited estrogenic activity up to 2 ng REQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic compounds, alkylphenols or phytosterogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng REQ/L. We analysed the presence of nine retinoid substances, where 4-keto all trans retinoic acid and retinol were the most common forms detected in the samples. Retinoid-like activity was almost fully explained based on concentration and relative potency of individual analysed retinoids. However, current results also suggest that still other compounds with retinoid receptor-mediated modes of action are present. Our study highlights the ability of co-existant retinoids to exert different effects, which might be important for determining the toxic potential of cyanobacterial blooms in aquatic environment such as fish or amphibians. The SOLUTIONS Project is supported by the Seventh Framework Programme (FP7-ENV-2013) of the European Union under grant agreement no. 603437.


There is a lack of information for estimating safe levels for aquatic life concerning the toxicity of natural toxins produced by cyanobacteria and algae. Literature indicates that LC50s for cyanotoxin in rainbow trout (Oncorhynchus mykiss) were observed at a concentration of 21 mg/L. There is even less ectotoxicity information available for prynmesin which is produced from the estuarine algae Prymnesium parvum. This flagellated alga has invaded freshwater systems in the U.S. and has caused numerous fish kills recorded in inland Texas lakes and blooms in 10 other states. Given the uncertainty with the purity of existing toxin standards and the cost of using them to conduct toxicity studies, a new approach is proposed using pure cultures and ambient bloom samples. Herrera, Echeverri and Ferrao-Filho (2015) conducted toxicity tests on several different cladoceran species using lyophilized phytoplankton samples collected from hydroelectric/drinking water reservoirs in Brazil. They found that reservoir samples with higher microcystin contents were the most toxic ones and that different cladocerans had different sensitivities to microcystin. In this study we have taken a similar approach but have used laboratory cultures of a toxin-producing strain of unicellular Microcystis aeruginosa, non-toxic producing filamentous strain of Anabaena floso-aquae and P. parvum. Each culture was centrifuged to separate cells from their respective culture media, then resuspended in moderately hard water. The M. aeruginosa cells were then frozen/thawed 3 times at -80°C. The P. floso-aquae cells were lyophilized. Forty-eight hour acute tests were conducted with Ceriodaphnia dubia, Hyalella azteca larval Pimephales promelas and Neoleocome triangularis on both strains. A similar procedure was also used on lake water samples collected during peak bloom conditions. Current results show microcystin concentrations of 74 μg/L did not cause any significant acute toxicity to any of the four test species. The filamentous non-toxic producer A. floso-aquae caused significant mortality to Neoleocome triangularis and H. azteca (only when tested in Moderately Hard Reconstituted Water but not in Reformulated Moderately Hard Reconstituted Water) which are both grazer feeders. Mechanism of effect is undetermined at this time. August 2017 Lake Harsha bloom sample (300,000 cells/mL > WHO high risk probability value) was not acutely toxic to any of the 4 test species. Additional P. parvum acute results and microcystin chronic results will also be presented.

TH191 Proteomic analysis of rice plant exposed to long-term microcystin-LR exposure. X. Zhang, Nanjing Institute of Environmental Sciences, MEP.

Irrigation with cyanobacterial-blooming water containing microcystins (MCs) poses potential threat to the growth of agricultural plants. Rice (Oryza sativa L.) is an important grain crop and is widely grown for domestic consumption in China. However, large amounts of rice field in the middle part of China has been irrigating with cyanobacterial blooms components and their complex mixtures, such as extracts and LPS isolated from different cyanobacterial strains and natural water blooms, should be also investigated in the future. The research was supported by the Czech Science Foundation Grant No. GJ17-23279Y and H2020-MSCA-ITN-2016 Project No.722493 NCtoxAq.

end.
respectively, and the different biological pathways involved in the mechanism of MC-LR-induced toxicity to rice were revealed using GO Term and KEGG analysis. Exposure to 1.0 µg/L and 50 µg/L of MC-LR could disturb the photosynthetic and ribosome pathways in rice leaves, causing the adverse effects on the normal growth and photosynthesis of rice. The significant alterations of the biological processes induced by the exposure to 50 µg/L of MC-LR were the inhibition of ribosome, porphyrin and chlorophyll metabolism, photosynthesis and terpenoid backbone biosynthesis related pathways, and the induction of thiamine, inositol phosphate metabolism, vitamin B6 metabolism and flavonoid biosynthesis related pathways in rice leaves. These results provided evidence of the molecular mechanisms underlying adverse effects in terrestrial plants exposed to water containing microcystins (MCs). Keywords: rice, microcystin-LR, photosynthesis, proteomics

Acknowledgments: This research was financially supported by the National Natural Science Foundation of China (Grant number 21407056).

Developments in the use of bioassays for chemical and environmental risk assessment (P)

TH194 Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dreissena polka verena (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (mortality and lysosomal membrane stability), and at tissue level (GPx and MTs), following the exposure to two perfluorinated alkyl acids (PFOA and PFBS) for short (72 h) and longer (14 and 28 days) times. The exposures were carried out in soil microcosms prepared with glass containers filled with 300 ml of soil humidified at 30% with PFOA or PFBS spiked water. As for the 72 h tests the exposures were performed, at two different nominal concentrations, i.e. 30% of 1x or 10x MAC-EQS fw values (Maximum Acceptable Concentration-EQS calculated by the Italian Working Group for the derivation of Environmental Quality Standard (EQS)) while for the long time the PFOA, or PFBS, nominal concentrations were 30% of 5x MAC-EQS fw values. Different accumulation patterns were observed for PFOA and PFBS, with PFOA no longer accumulating between 14 and 28 days, while PFBS continues to be accumulated up to 28 days. Significantly higher coelomocyte mortalities than in the controls, with both compounds, were detected after the 14 and 28 days exposures. As for the lysosomal membrane stability significant decreases were detected both after the short and the long-time exposures. In the soft tissues primary data don't show significant differences between control and treated organisms regarding the GPx activity. A significant MT total decrease was detected after PFOA exposure, both at 14 and 28 days while after PFBS exposure only at 14 days. As for MT, because it has been reported that PFA are able to increase ROS levels, we determined not only the total protein concentration but also the oxidized fraction (MTox). A significant increase in the MTox fraction in PFOA treatment after 28 days and in PFBS after 14 days was observed. Our results show, for this invertebrate organism, a higher PFBS bioaccumulation than PFOA and significant exposure effects to the two PFAS both in coelomocytes, the main immunodefensive system cells of the organism, and in the soft tissues. Further studies are planned to explore the mechanisms underlying these results.

TH193 Organ distribution of the environmental neurotoxin β-N-Methylalino-L-alanine in the freshwater mussel Dreissena polymorpha A. Lepoutre, UMR102 INERIS-URCA-ULH SEBIO, E. Faassen, RIKILT, A. Geffard, Université de Reims Champagne Ardenne; E. Lance, Université Reims Champagne Ardennes / Biology and Biochemistry Among toxic cyanobacteria, the microcystins, are known for their neurotoxicity. The α-(β-N-Methylalino-L-alanine), a hydrophilic non-proteinogenic neurotoxic amino acid, has the ability to accumulate in marine and freshwater food webs, as well as in that vertebrates’ brain. This toxin can promote long-term human neurodegenerative pathologies such as amyotrophic lateral sclerosis (ALS). Human exposure could occur during the ingestion of BMAA-containing food, as this neurotoxin has been detected in animals destined to human consumptions like fish, mussel and oysters. However, BMAA is an emerging toxin from which little data of toxicity or occurrence in the environment are available. In a context in which human activities are promoting the development of phytoplankton, it is important to gather information about this toxin. The zebra mussel Dreissena polymorpha is a freshwater bivalve, known for its ability to bioaccumulate substances (MCs). The development of these additional PFAS and classes of organophosphate pesticides could be assessed upon completion of the upper trophic level exposure studies. Once all phases of toxicity testing are complete, the results will be used to help develop a...
risk management framework for addressing potential environmental management issues of PFAS.

**TH196** Interpretation of bioassay results in the context of the soil quality TRIAD approach.

N. Pandur, J. K. Poulsen, INERIS; S. Andres, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances; P. Pandur, INERIS / Expertise and assay in ecotoxicology unit

The recently standardized method ISO 19204 “Soil quality – Procedure for site specific ecological risk assessment of soil contamination (Soil quality TRIAD approach)” describes in a general way the application of three combined lines of evidence (chemistry, ecotoxicology and ecology) along a tiered approach. Regarding the ecotoxicological component, the TRIAD approach consists in carrying out a battery of bioassays on soil samples and to scale the results from all bioassays to calculate an ecotoxicological combined risk score. In order to evaluate its applicability and the relevance of the proposed tools, INERIS used the soil quality TRIAD approach on an applied case: an open mine operated for 60 years and which the site was contaminated with heavy metals, hydrocarbons, etc. These values can be applied to environmental risk assessments for heterogeneous sites and for the first TIER (screening level) of the TRIAD method. This statement is illustrated by observing the consequences on the assessment conclusion when the results of bioassays are expressed according different control/reference soils.

**TH197** Estimating the hazardous concentrations of nonylphenol for soil ecosystem protection with the TRIAD approach.

J. Kaak, J. Mooi, D. Kim, Konkuk University; R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science

Nonylphenol is known as a xenoestrogen but is still used for pesticides, detergents, surfactant cleaners and packaging. However, few researches on soil ecotoxicity of nonylphenol were reported. In the present study, we conducted a battery of bioassay, generated soil ecotoxicity data and then estimated soil hazardous concentration for nonylphenol for soil ecosystem protection based on species sensitivity distribution (SSD). For the acute assay, eight soil species from six different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae, seccenterna, ciliatella and collombella) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and collombella) were investigated. Finally, acute and chronic hazardous concentrations for HCl, HCO3-, H3O+ were suggested for protection of soil ecosystem. These values can be applied to environmental risk assessments for nonylphenols. This study was funded by the Korea Ministry of Environment (MOE) for the Environmental Health Action Program (1485014458)

**TH198** Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transthyretin In Vitro

K.L. Hill, Intrinsik / Department of Biology; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division; T. Hamers, Wageningen University Amsterdam; Institute for Environmental Studies (IVM) / Department of Environment and Health; J. Kamstra, NMBU / BaSam; W. Willmore, Carleton University / Department of Biology

The toxicological properties of organophosphate (OP) triesters that are used as flame retardant and plasticizer additives are currently not well understood. The toxicological properties of OP triesters, TDCIPP (tris(1,3-dichloro-2-propyl) phosphate), TBOEP(tris(butoxyethyl) phosphate), TEP (triethyl phosphate), TPHP (triphenyl phosphate), p-OH-TPHP (para-hydroxy triphenyl phosphate), and the OP diester DPHP (diphenyl phosphate), to access the second site of the TH binding pocket was found to be competitive with hTTR. Chemically related methoxylated OP triesters, TDCIPP, DiPhOBz was found to be capable of competing with thyroxine (T4) for the binding site on human TTR and ALB. Para-OH-tetrabromo-DiPhOBz was found to be competitive with both TH binding sites on TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive than all other OP triesters. They may be related to the changes in COX enzyme and hydroxy-analouges, using an in vitro competitive protein binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB).

**TH199** In Vitro and In Silico Competitive Binding of Brominated Polyphenyl Ether Contaminants With Human and Gull Thyroid Hormone Transport Proteins

K.L. Hill, Intrinsik / Department of Biology; D. Mortensen, NTNU University / Department of Biology; D. Tetelecki, Accustandard; W. Willmore, Carleton University / Department of Biology; I. Sytle, The Arctic University of Norway / Department of Medical Environmental Health; J. Willmore, Norwegian University of Science and Technology / Biology; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division

Tetradeacabromo-1,4-diphenylbenzoxenyl (TeDB-DiPhOBz) is a highly brominated additive flame retardant (FR). Brominated photodegradates of TeDB-DiPhOBz have been shown to be enzymatically hydroxylated in vitro in herring gulls (Larus argentatus) liver assays, including one metabolite identified as 4′-OH-2,2′,4′-tetrabromo-DiPhOBz. Chemically related methoxylated tetrabromo- to hexabromo-DiPhOBz are known contaminants in herring gulls from the Laurentian Great Lakes of North America. To our knowledge, nothing is currently known about the biological effects of these polybrominated (PB) DiPhOBz-based compounds. The present study investigated the potential thyroid hormonotoxicity of 2′,2″,4′-tetrabromo-DiPhOBz. Three strains of S. oryzae– and hydroxy-analouges, using an in vitro competitive protein binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). Para-OH-tetrabromo-DiPhOBz was found to be capable of competing with thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive than all other OP triesters. They may be related to the changes in COX enzyme and hydroxy-analouges, using an in vitro competitive protein binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB).

**TH200** Phosphine changes cytochrome c oxidase in Sitophilus oryzae

K. Kim, H. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee, Kyungpook National University

Phosphine resistance in the stored product insect pests has been reported over the world. In South Korea, Sitophilus oryzae has been developed phosphine resistance after the severe use of phosphine. In this study, how S. oryzae survived under the recommended dose of phosphine and we assessed the biochemical and molecular mechanisms for enduring resistance. Three strains of S. oryzae were prepared as control groups (C), medium-resistant group (MR), and strong resistant groups (R) for this study. One of target sites of phosphine is cytochrome c oxidase (COX) and we analyzed the enzyme activities within the three strains. The highest COX activities were found in R groups with about 1.5-fold increase when compared to the controls. IC50 values on the COX activity by ethyl formate, one of COX inhibitors, was 2.82, 3.71 and 4.55 mM for C, MR, and R strains. Lineweaver-Burk plot for COX using ethyl formate exhibited different modes from R strains to C strains. And six genes cat, jhip, voltage, casp, wnt7, wnt11 were analyzed using RT-PCR for comparing gene expression and cat gene was dramatically down-regulated in the R strain. jhip gene expressing juvenile hormone inducible protein was differently expressed in the two phosphine-resistant strains, which was also up-regulated, and COX enzyme and wnt7 gene were down-regulated in the R strain, but it was not so big different. Three biomarker enzymes such as acetylcholinesterase, glutathione S-transferase, and carboxylesterase activities were also determined within the three strains. Only glutathione S-transferase activity decreased in the R strain. Taken together, phosphine resistance in S. oryzae may be related to the changes in COX enzyme and up-regulation of jhip gene expressing juvenile hormone inducible protein.

**TH201** Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS

S. Baek, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe; Y. Kim, KIST Europe / Environmental Safety Group

Glutathione is an important non-protein compound and existed in both internal and external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) of glutathione is one of important biomarkers. Among all available assays to detect and quantify GSH and GSSG, using high-performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) is very essential with the development of highly sensitive and sensitive analytical methods. GSH and GSSG are usually analyzed in positive ionization in electrospray, and formic acid can be a general additive in mobile phases for a better protonation in positive ionization mode in MS. In this work, we investigated the effects of additives other than formic acid for a better understanding to enhance the ionization of GSH and GSSG in the gas field of MS source. With the presence of formic acid only, as a result, protonation of GSSG was very limited. However, using formic acid and ammonium acetate together in mobile phases delivered the enhancement of protonation for both GSH and GSSG. Furthermore, as increasing the concentration of ammonium acetate from 5mM to
50mM, sensitivities of GSH and GSSG were increased from 0.0034 to 0.0072 and 0.028 to 0.046, respectively. Detection limits of both GSH and GSSG were also significantly lowered as using higher concentration of ammonium acetate. This indicates that producing ammonium adducts followed by dissociating ammonium ions from adducts to protonate GSH and GSSG is important mechanism for protonation of these compounds with using ammonium acetate as a mobile phase additive. This enhanced sensitivity was also verified using zebrafish (ZEL) to investigate the recovery of both GSH and GSSG and achieved more than 100% recovery for GSH and around 100% recovery for GSSG. The achievement of higher recovery of GSH than 100% was because ZEL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZEL exposed to different concentrations of a target chemical as well as 6 mg/L of H$_2$O$_2$, a negative control. The lowest concentration of GSSG in this work was 5.0 ng/mL, higher than its detection limit, 2.0 ng/mL. This is meaningful because it could not be achieved by other conventional methods and assays with higher detection limit than its original concentration. Therefore, we can conclude that our method could avoid underestimation to quantify biomarkers such as GSH and GSSG.

**TH202 Rapid analysis of bivalves’ xenometabolome using High Resolution Mass Spectrometry**

D.A. Muñoz, Water and Soil Quality Research Group, Department of Environmental Chemistry, IDAEA-CSIC / Water Quality; M. Olmos, IDAEA-CSIC / Water and Soil Quality Research Group; M. Rambla-Alegre, IRTA; S. Morell, N. Guíllem, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; J. Diogène, IRTA / Marine Environmental Monitoring Subprogram; M. Farre, IDAEA-CSIC / Environmental Chemistry; M. Lopez de Alda, Institute of Environmental Assessment and Water Research; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry

Aim: To quantify xenobiotics and environmental contaminants are released to the environment every day from residential, commercial and industrial uses. They are simultaneously present at different levels in aquatic ecosystems making a “cocktail” of hazardous substances. These xenobiotics interact with wild organisms and may be bioaccumulated. They can have negative implications from an environmental point of view, affecting wild life, but also they may be of great concern from a human health perspective, when they accumulate in highly conserved organisms like bivalves. Given that it is unrealistic to assess every possible combination of chemical substances accumulated by organisms, the major challenge now is to develop systematic ways of addressing these chemical mixtures, and to identify priority mixtures of potential concern. For this purpose, the profiling of the xenometabolome, or range of xenobiotics and their metabolites in an organism exposed to environmental contaminants, seems to be the way forward. In the present work, for the profiling of the xenometabolome, a fast analytical method has been developed for the extraction and identification of priority contaminants in bivalves from Ebro Delta, Spain. A literature research was done in order to gather all the information available regarding the Ebro Delta and possible sources of contamination. Taking into account the information and mixture of compounds representative of the different contaminant sources identified in the area was selected. This mixture including pesticides, plasticizers, antibacterials, preservatives, stimulants, and pharmaceuticals was used for a recovery study with three different bivalves types of high commercial interest such as mussel, oyster and cockle. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) was used for the extraction and purification of the purificaction extracts were injected in Orbitrap-Q-Exactive for identification and quantification of the priority contaminants. Twenty compounds including endocrine disrupting compounds, pesticides, and pharmaceuticals were extracted with recoveries ranging from 40.54 to 105.51 %. Quality parameters such as method detection and quantification limits, accuracy, and precision were studied. Besides, non-target analysis of other relevant contaminants that may be present in bivalves’ xenometabolome is ongoing.

**Acknowledgements** CTM2015-73179-JIN (AEI/FEDER/UE); GLOBAQUA (603629); 2014 SGR 418; Bekolut and Merck.

**TH203 River ecosystem: an ecosystem approach to evaluate the ecological risk linked to the human health protection**

L. Mancini, Istituto Superiore di Sanità / Department of Environment and Health; C. Puccinelli, Italian Institute of Health ISS / Department of Environment and Health; L. Tancioni, University of Rome Tor Vergata / Biology department; M. Carere, Italian Institute of Health ISS; E. D’Ugo, Italian Institute of Health ISS / Department of Environmental Health; S. Mancini, Italian Institute of Health ISS / Department of Environmental and Health; R. Giuseppetti, F. Chiudioni, Italian Institute of Health ISS / Department of Environment and Health; S. Marchegiani, Istituto Superiore di Sanità / Department Environment and Health

The anthropogenic pressure on river ecosystems can induce changes on their structural and functional characters as well as an increasing risk for human health. Over the last years an ecosystem approach mainly based on multilevel bioindicator methods has been used for assessing the risk for human health. The samples processing plays a key role in the environmental analysis. Samplings were carried out in an area characterized by strong anthropogenic pressures (Tiber River Central Italy). The water samples were processed using the technique of filtration and concentration, as suggested within the European project μAQUA FPVII; at the same time, tests were carried out using raw water samples. The approach of this study is based on the following parameters: biological community (diatoms, macro invertebrates, macrophytes and fishes fauna); chemical–physical parameters, a set of ecotoxicological bioassays (Vibrio fischeri, Daphnia magna and Vicia faba), microbiological analysis (Salmonella spp, Staphylococcus spp, Clostridium spp. and Campylobacter upgird and virological analysis of insect, nematode and viral Hepatitis A, HAV and HEV, Norovirus NoGI and NoGII, Reovirus, Enterovirus: A, B and C, Adenovirus: ADV40 and ADV41). The results of this study showed that the pre-concentration of larger amount of water improves both the contaminants detection within aquatic ecosystems and the ecological risk evaluation. The ecotoxicological analysis is an important aspect in the integrated approach to evaluate the ecological risk linked to the human health protection. The integrated approach adopted has been a useful tool to describe the ecological status of surface waters and the related risk for human wellbeing, providing a complete and organic vision of the qualitative state of the ecosystem. In conclusion these results highlighted the different levels of alteration and the potential need for the primary prevention and restoration, confirming that an ecosystem approach plays a key role in the ecological and human health risk assessments.

**TH204 INTEGRATED EXPOSURE AND EFFECT DATABASE TOOLS TO SUPPORT HAZARD AND RISK ASSESSMENT**


Use of available exposure and effect data are key to performing hazard and risk assessment of pollutants, and compiling different sources of data are often done in a case-by-case manner. Processing data is the cumbersome and time consuming task, whereas the availability of data is a large source of uncertainty in resulting assessments. The NIVA Risk Assessment database (NIVA RAdbs(TM)) has been developed as a module-based tool to facilitate the assembly, organisation, integration, visualisation and quality assurance of available exposure and effect information in order to feed up and perform consistent handling of relevant data. The NIVA RAdbs(TM) compile available experimental and predicted (computational) effect data that range from molecular and cellular responses characterising the mode of action (MOA), typically derived from high-throughput and high-content (in vitro) bioassays, to (apical) adverse data derived from whole organism bioassays of potential regulatory relevance. These effect data are assembled within the context of Adverse Outcome Pathways (AOPs) here by anchoring data to initial cellular responses referred to as molecular initiating events (MIE), to downstream key events (KE) at the cellular/organ level and finally to adverse outcomes (AO) at the individual or organism level. The resulting multi-level assemblies of data can be used in hazard assessment to identify the MOA of one or more stressors, to link molecular responses to higher organisation level effects and to identify potential stressors among large assemblages of pollutants that can give rise to a given AO. The NIVA RAdbs(TM) also support risk assessment by calculating risk quotients (RQs) of single pollutants and mixtures of these on basis of exposure (typically measured or predicted environmental concentrations) and effect data (typically NOEC, ECx, PNEC or EQS values) and can identify risk drivers (most toxic chemicals), relevant toxic endpoints (i.e. MIE, KE and AO) and susceptible species for a given exposure scenario. Recent development includes the integration of non-chemical stressors such as ionizing and non-ionizing radiation. Examples on uses specific exposure scenarios will be presented to show the utility of the databases and the tools developed.

**Acknowledgements**: RCN projects 221455-EDRISK (www.niva.no/edrisk), 268294 MixRisk (www.niva.no/mixrisk), 223268 CERAD (www.mmbu.no/en/services/centers/cerad), and EU FP7 project SOLUTIONS (http://www.solutions-project.eu/project/)

**TH205 Assessing exposure risk for marine bivalve Mytilus posidonia microplastephytene particles**

C. C. Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering; H. Lin, National Taiwan University; C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering

**BACKGROUND**: Microplastics (MPs) are one of the most widespread emerging pollutants in aquatic ecosystems, posing impacts on marine organisms. However, little is explored for potential risks of environmentally relevant concentrations of MPs and MP based on bioassay results from related published studies. Recent development of new integration of non-chemical stressors such as Mytilus posidonia microplastephytene Mytilus posidonia microplastephytene MPs and MP based on bioassay results from related published literature.

**METHODS**: We used Hill-based dose-response model to simulate the effects of PS-MPs on the lysosomal destabilization and phagyoysis in bivalves. The predicted no-effect concentrations (PNECs) causing 1% inhibition of immune functions were also estimated using a combination of risk-based probabilistic model was used to characterize the potential hazards of marine bivalves in response to predicted environmental concentrations (PECs) of PS-MPs or by quantifying exceedance risks (ERs) and hazard quotients (HQs) in five plastic-filled gyres.
RESULTS: We found that PNECs for inhibition of lysosomal membrane stability and phagocytosis cells were 0.04 and 0.07 μg mL⁻¹, respectively, implicating that phagocytosis is a more sensitive endpoint for immune responses in bivalves. In addition, our results demonstrated that the North Pacific Ocean appeared to be the greatest risks among global oceans. CONCLUSIONS: The strict thresholds estimated by applying a environmental risk assessment framework could be recommended as a criteria for environmental management of PS-MPs or MP-Ps. Potential effects of PS-MPs/MPs on marine organisms at higher trophic levels should also be taken into consideration. Keywords: Polystyrene microplastics; Bivalve; Environmental risk assessment; Predicted no-effect concentration; Predicted environmental concentration; Hazard quotient

TH207
Innovative Design of Nationwide Dutch Water Quality Monitoring
M. de Baat, University of Amsterdam / IBed-FAME; Y. Coolen, D. van der Pouw Kraan, R. Rood, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBed-FAME
According to the European Union Water Framework Directive (EU-WFD), chemical surface water quality is assessed by analysing the concentration of 45 priority compounds. However, the analysed chemicals are often absent and biological effects are thus caused by (un)known (mixtures of) compounds. Alternatively, water quality can be assessed by observing adverse effects of surface water on test organisms. Therefore, the present study aimed to innovate surface water quality assessment by applying an innovative design in a nationwide monitoring campaign in The Netherlands. To this purpose bioassays with two aquatic invertebrate species, Daphnia magna and Chironomus riparius, were employed and the performance of passive sampling techniques to include time integrated compound concentrations was explored. D. magna neonates and C. riparius larvae were exposed to surface water samples from 34 locations. Daphnids were additionally exposed to POCIS passive sampler extracts from 7 of these locations. For the daphnids, none of the surface water samples or passive sampler extracts caused significant mortality after 48h of exposure. In contrast, for the chironomids, three surface water samples caused significantly lower larval survival compared to the controls. The use of C. riparius bioassays thus allowed for differentiation between water quality of the sampling locations. Possible explanations for the observed chironomid mortality include insecticide sorption to the provided food, which may lead to increased exposure resulting in higher mortality. A possible culprit compound could be the neonicotinoid imidacloprid, which was detected at two locations with observed chironomid mortality. Moreover, toxicity of imidacloprid to C. riparius is 500 times higher than to D. magna. This could thus explain the high mortality at these greenhouse locations. It is hypothesized that the use of bioassays with multiple test species provides better insight into surface water quality, and is therefore a valuable addition to regular water quality monitoring.

TH208
Smart Monitoring: Application of innovative tools in nationwide water quality assessment
M. de Baat, M. Kraak, University of Amsterdam / IBed-FAME; R. van der Oost, WaterNet / Onderzoek en Advies; P. de Vooight, University of Amsterdam / IBed; P. Vordonschot, University of Amsterdam / Department of Freshwater and Marine Ecology
The European Union Water Framework Directive requires member states to assess chemical water quality of surface waters by monitoring the presence of 45 priority substances. However, these substances are often banned and their concentration in surface waters is strongly decreased, frequently to levels below the limits of detection. Simultaneously, industries have switched to a myriad of alternative compounds that have serious impacts on water quality, most of which are not listed as priority substances. Consequently, a large portion of the observed toxic effects of surface waters cannot be attributed to compounds measured by the authorities. Hence, there is an urgent need for an effect-based monitoring strategy that employs bioassays to identify environmental risks. Therefore, the aim of the present study was to implement innovative tools in a smart, integrated monitoring strategy, applied in a nationwide water quality assessment campaign in The Netherlands. The monitoring strategy is based on novel bioassays (PS) with a battery of bioassays to investigate ecotoxicological risk to aquatic biota. At 47 locations silicone rubbers and Polar Organic Chemical Integrative Samplers (POCIS) were exposed to surface water for 6 weeks. Alongside the PS a 7-day in-situ daphnid test was performed at all locations. Subsequent to field exposure, accumulated compounds were extracted from the PS after which a battery of 3 in vitro assays were performed. The bioassay D. magna eXpression (CALUX) bioassays was exposed to the re-dissolved extracts. The bioassay battery was selected such that it can identify the risk posed by a wide range of chemical pollutants and their transformation products, while simultaneously allowing for more targeted identification of groups of compounds that cause specific effects. Bioassay responses were compared to effect-based trigger values to identify potential ecotoxicological risks at the investigated locations. Subsequently, the SIMONI model was applied to rank sites based on ecotoxicological risk, rather than on the presence of priority compounds. It is concluded that the Smart Monitoring strategy allowed prioritization of sites based on ecotoxicological risks, identified the presence of hazardous compounds, regardless of being listed as priority compounds, but meanwhile could prevent costly chemical analysis at sites with low ecotoxicological risks.

TH209
Passive sampling in effect-based monitoring of two European rivers - ex-availability of in vitro detected chemicals
J. Novak, Masaryk University / RECETOX; Z. Toussova, B. Vrana, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; F. Smeeds, RECETOX / Environmental chemistry and modelling; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrozoans; S. Aït-Aissa, INERIS / UMR SEBIO ECOT; M. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; K. Hilirschova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment
RECETOX EU commission Water Framework Directive considers employment of passive sampling and use of effect-based tools in the monitoring of aquatic pollution. A combination of both approaches was used for monitoring of two rivers differing significantly in pollution levels. The Bosna, moderate-sized river in Bosnia-Herzegovina, which is burdened by untreated wastewaters, was sampled by semipermeable passive sampling devices (SPMD) and POCIS samplers. The Danube, the largest river in the EU with relatively low pollution level, was sampled using a mobile dynamic passive sampling device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar-ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance reference compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or calculated from non-background levels which were detected both in adsorption (ED) and partitioning samplers (SR). The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQₐ), of respective model compounds in water. The BEQₐ levels were significantly higher in extracts from POCIS and ED samplers showing that the polar chemicals were responsible for most of the detected effects. Chemical analyses detected 103 and 209 chemicals in the Bosna and the Danube samples, respectively. The passive sampling allowed detection of chemicals at pg/L concentrations. The levels of chemicals with known biological potency for the studied endpoints were used for modeling of bioanalytical equivalents (BEQₐ). The conversion of bioanalytical equivalents into bioanalytical equivalents showed that the detected chemicals explained mostly a low fraction of the BEQₐ. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQₐ was comparable with the BEQₐ levels. Both sampler combinations proved to be suitable for the detection of a large set of chemicals even at trace levels and for the comprehensive assessment of the biological potentials of the environmental mixtures. The SOLUTIONS Project was supported by the 7th Framework Programme EU (FP7-ENV-2013) with grant agreement no. 603437.

TH210
Testing of realistic contaminant mixtures with the harpacticoid copepod species Nitocra spinipes using passive sampler extracts
K. De Schamphelaere, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; J. Koch, GhEnToxLab (Ghent University) / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology
The use of passive sampling as a tool in environmental monitoring has gained wide acceptance within the past decades. More recently the possibilities of combining passive sampling and biotesting gained higher attention and researchers focus on reconstituting environmentally realistic contaminant mixtures in aquatic biotest systems. Equilibrium based samplers (e.g. silicone rubber sheets) can mostly be used as passive dosing devices in biotest systems without prior treatment but have the disadvantage that only one single concentration level can be tested. For more advanced samplers (e.g. Speedisks™) an extraction is needed before spherical of biotest medium and the downside of this approach is that an extraction always changes the natural mixture composition due to compound specific partition coefficients. The advantage on the other hand is that the extraction of the samplers is well established, efficient and easy to combine with chemical analysis. Thus, even though this approach does not reconstitute the natural concentration profile quantitatively it allows the use of environmental passive sampling devices in biotests to assess realistic contaminant mixtures in terms of qualitative chemical composition. In the current study we extracted Speedisk™ passive samplers that were deployed for 8 weeks in two Belgian harbours and one location next to one of the harbours to spike a 7-day larval development test with the harpacticoid copepod Nitocra spinipes following ISO 18220. In order to fractionate the compounds on the Speedisks™ we followed two different procedures: a sequential and a parallel extraction approach using three solvents: acetone, ethyl acetate and dichloromethane. We exposed 80 larvae divided into 8 replicates in a fully randomized setup including controls and solvent controls to each of the Speedisk™ extracts and counted larvae and copepodites after
5. 6 and 7 days to calculate the larval development ratio. Results showed no statistically significant developmental effects for all tested extracts. The tested concentrations after solvent spiking in our test system were slightly below environmentally realistic contaminant concentration levels. Overall the larvae showed to be unaffected by the exposure to the SpeedSkX™ extracts and we expect no direct effects of environmentally realistic contaminant mixtures on the development of *N. spinipes*.

**TH211**

**Passive dosing of polar and non-polar substances using Oasis HLB® - Pre-equilibration of media for transferring complex mixtures.**

D. Kämper, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research (BioV); T. Seeler, RWTH Aachen University / Ecosystem Analysis; H. Hollett, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaefter, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

The passive dosing approach is currently focused on hydrophobic organic substances. Dosing phases such as polydimethylsiloxane (PDMS) silicone are suitable for this task, but also limit the approach to specifically this group of substances. However, metabolism, volatilization and sorption – particularly medium sorption – are also highly relevant for polar substances. Therefore, a requirement for the passive dosing of these substances also exists. To overcome the current limitations of silicone, the applicability of Oasis HLB for dosing polar and non-polar substances was tested in a neutral red assay. The findings show a high affinity of Oasis HLB for hydrophobic analytes. Despite this, the adsorption-based accumulation of the substances was reversible and – due to the high surface area and the wettable pores – relatively fast. This demonstrates its suitability for dosing a broad range of substances. With respect to combining equilibrium passive sampling and dosing for the recreation of field mixtures in toxicity test, pre-equilibration of the cell culture medium with Oasis HLB was successfully tested and compared with the direct dosing using Oasis HLB. On the one hand, the medium pre-equilibration approach enables one to control the role of temperature on the equilibrium state. On the other hand, due to the fact that the dosing phase is not directly introduced in the assay, maintaining the test concentration over the test duration is diminished for some compounds. In summary, the application of Oasis HLB as a passive dosing phase was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broad mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

**TH212**

**Passive dosing strategy for in vitro test systems: static concentration generator and continuous release.**

F. Begnaud, Firmenich / DRAP; C. Debonville, Firmenich / Research and Development; V. Laubscher, F. Berthaud, Firmenich SA / DRAS; H. Schug, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Toxicology, University of Bern / Centre for aquatic Life Health; K. Schirmer, Eawag / Environmental Toxicology, H. Segner, University of Bern / Centre for Fish and Wildlife Health; S. Gimeno, Firmenich / Product Safety and Regulatory Affairs

The ability to generate a true solution of a chemical substance at controlled concentrations is essential to generate meaningful aquatic toxicity information. The in vitro test systems, in particular, becomes highly challenging when dealing with hydrophobic (logKow > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro bioconcentration test with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant concentration in a selected compartment of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous enrichment. Specific handling tools and concentration strategies were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

**TH213**

**Identification of Gestagen(s) and Corticosteroid(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach.**

M.A. Hashmi, M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

**Biologically active substances (generally termed as endocrine disrupting chemicals (EDCs)) are present in untreated municipal wastewater, which may cause deterioration of freshwater ecosystem due to their potential to disrupt the endocrine system of aquatic organisms. Untreated municipal wastewater is directly discharged into Danube River, Novi Sad, Serbia and the objective of the study is to identify compounds responsible for endocrine disrupting effects in Danube river water by using non-target screening. Water sample from Danube River were extracted on-site using large volume solid phase extraction (LVYPE) and was pre-screened on genetically modified bioassays for agonistic and antagonistic hormonal activity for progestrene and glucocorticoid receptors (PR and GR). The exact identity of the cytoxic compounds responsible would not be revealed due to the cytotoxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C-18 silica based column. Two minute fractions were collected (total 30 fractions) and applied on respective bioassays and identified one agonistic active fraction for both PR and GR. Second step fractionation was performed on the only active fraction by using anionexchange column with gradient elution with methanol-water (50:70) with 0.1% formic acid. One to two minute fractions (total 28 fractions) were collected and biological analysis of these sub-fractions revealed again one active fraction with reduced potency as compared to F18 (parent fraction). For unraveling the compounds responsible for gestagenic and corticoid activity, non-target screening is being performed by using LC-HRMS.**

**TH214**

**Mixture Risk - Development of an effect-based chemical risk assessment strategy for sites contaminated with complex mixtures of organic and inorganic contaminants.**

G. Nilien, B. Holmes, M. Larsson, Orebro University / M. Technology – Environment Research centre (MTM); N. Scherbak, Orebro University / School of Science and Technology, Life Science Centre; M. Engwall, Orebro University / Man-Environment-Environment research centre (MTM); S. Keiter, Orebro University / MTM Research centre

Environmental contamination is usually comprised of a mixture of pollutants, each of them bearing the potential of causing different toxic responses towards humans and wildlife. Recent risk assessments still generally rely on chemical analyses only; however, such investigations do not provide information regarding the interactions between chemicals including their integrated toxicity. The limited knowledge of the risks associated with mixture toxicity is the starting point for this study, and is part of the EnFor project that aims to investigate the toxic responses of mixtures of pollutants and integrate these results to risk assessment. In particular, per- and polyfluorinated alkyl substances (PFAS) are of major concern as they are extremely persistent and able to alter the toxicity of other pollutants. However, preliminary results showed that selected PFASs were not able to alter mechanism-specific toxic effects *in vitro*, while they decreased gene expression of the same mechanism using an *in vivo* model with zebrafish embryos. Moreover, so far no vertebrate based test system exists to quantify the toxic response of PFASs; thus, one objective of the project is to develop a bioanalytical tool for measurement of PFAS contamination. The toxic effects of environmental samples will be assessed by a combination of biotests and chemical analysis. For the identification of non-target pollutants, effect-directed analysis will be used consisting of fractionation, chemical analysis and biotests. In addition, the project aims to fill crucial gaps in the knowledge regarding molecular and cellular effects of PFASs in *in vitro* test systems, and becomes highly challenging when dealing with hydrophobic (logKow > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro bioconcentration test with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant concentration in a selected compartment of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous enrichment. Specific handling tools and concentration strategies were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

**TH215**

**Analyzing chemical pollutants in water samples from an urban river and wastewater effluent in Hyderabad (India) and their ecotoxicological effects using effect-directed analysis (EDA).**

J. Daniel, RWTH Aachen University; P. Böhm, RWTH Aachen University / Department of Ecosystem Analysis; J. Aihleim, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; A. Dayakar, Gamana NG, D. K. Khandarkar, A. Sathish Madras / Department of Civil Engineering; V. Schiller, RWTH Aachen University / Department of Ecosystem Analysis; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; S. Fleetwood, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; S. Schiwi, RWTH Aachen University / Department of Ecosystem Analysis; T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; H. Hollett, RWTH Aachen University / Institute for Environmental Research

In India, surface water contamination in urban areas is a common issue. One major source of pollution may result from the discharge of treated and untreated wastewater, both domestic and industrial in receiving environments. This contamination composed of a complex mixture containing e.g. polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from industries or pharmaceuticals from residential waste may pose a risk not only to the environment but also human health. Previous studies have reported a strong presence of...
multi-resistant bacteria in the Musi River, which might be due to large pharmaceutical production located in Hyderabad. A cooperation between the Department of Ecosystem Analysis RWTH Aachen (ESA), the Helmholtz Centre for Environmental Research Leipzig (UFZ) and the Civil Engineering Department from the Indian Institute of Technology Madras (IITM) was formed to evaluate the water quality in the Musi River, an urban river in Hyderabad (Telangana state, India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOI: 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary and one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogenscreen. Further evaluation of the data and investigation on genotoxicity using the AMES assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riveric ecological effects.

TH216 Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays

B. Patil, M. Junghans, P. Devaraj, J. Daniel, RWTH Aachen University / Department of Ecosystem Analysis; A. Dayakar, Gamama NGO Hyderabad; A. Sathish Lekha, J. Vijayan, I.M. Nambi, Indian Institute of Technology Madras / Department of Civil Engineering; V. Schiller, RWTH Aachen University / Department of Environmental Research, UFZ Helmholtz Centre for Environmental Research Leipzig (UFZ) has been formed. For a cooperative assessment between environmental engineers from the Indian Institute of Technology Madras (India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOI: 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary and one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogenscreen. Further evaluation of the data and investigation on genotoxicity using the AMES assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riveric ecological effects.

TH218 An ecotoxicological assessment of Lake Mondsee, Austria: a two year survey

P. Soares, EPFL / Aquatic Ecotoxicology; M. Koster, Amt für Umwelt, Thurgau / Swiss Centre for Applied Ecotoxicology Eawag; H. Hollert, RWTH Aachen University / Department of Environmental Research, UFZ Helmholtz Centre for Environmental Research Leipzig (UFZ) has been formed. For a cooperative assessment between environmental engineers from the Indian Institute of Technology Madras (India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOI: 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary and one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogenscreen. Further evaluation of the data and investigation on genotoxicity using the AMES assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riveric ecological effects.

TH217 NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments

M. Langer, Centre Ecotox EAWAG-EPFL / Aquatic Ecotoxicology; M. Junghans, Centre Ecotox EAWAG-EPFL; S. Spycher, Eawag Swiss federal Institute of Aquatic Science and Technology; M. Koster, Amt für Umwelt, Thurgau / Wasserqualitaet; C. Baungartner, AquaPlus; E. Vermeirssen, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on related topics. The latest focus study evaluated pesticides in sediments and in catchment water, and included agricultural land use. For this purpose five small streams were sampled from the beginning of March to the end of August using half-day composite samples and an analytical method covering 213 active substances. The chemical analysis was complemented with several biological investigations. Measured concentrations of pesticides were used to determine the risk of pesticide mixtures. Using acute and chronic effect-based water quality criteria (QC), we calculated risk quotients (RQ). In a second step RQs of individual compounds were summed to provide separate mixture RQmix for plants, invertebrates and fish. In all the tested water bodies a chronic mixture risk with RQmix > 1 was determined. There was a chronic mixture risk at three sites for almost the entire sampling period. Consequently this resulted in no recovery time for aquatic organisms. An acute mixture risk was determined for four streams, with two of them showing high risks with RQmix greater than 10. In addition a mixture risk was investigated to what extent the predicted mixture risk of herbicides was consistent with endpoints that are determined in the combined algae test. This test provides information on the inhibition of photosystem II (PS II) and algae growth. The resulting risk corresponded very well with the calculated mixture risk for PS II inhibitors. In one stream PS II inhibiting plant protection products dominated the ecotoxicological assessment. For an assessment of Lake Mondsee was carried out. Water (W) and sediments (S) samples were collected from Lake Mondsee and the reference site, Lake Irsee, on three different seasons: 1) summer 2015 (preliminary assessment of W and S samples’ toxicity), 2) spring 2016 (possible best-case scenario, since lake was frozen for the winter) and 3) summer 2016 (worst-case scenario, tourist activities peak). The WWTP inflow and outflow, plus pre-thickening (PS) and the WWTP outflow (S), samples were collected for target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogenscreen. Further evaluation of the data and investigation on genotoxicity using the AMES assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riveric ecological effects.

TH219 Availability of estrogens applied onto 96-well plates in the LYSES

M. Ragulan, Swiss Centre for Applied Ecotoxicology Eawag-EPFL / Department of Environmental Research, Dept. of Environmental Analysis; H. Hollert, RWTH Aachen University / Department of Environmental Research, UFZ Helmholtz Centre for Environmental Research Leipzig (UFZ) has been formed. For a cooperative assessment between environmental engineers from the Indian Institute of Technology Madras (India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOI: 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary and one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogenscreen. Further evaluation of the data and investigation on genotoxicity using the AMES assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riveric ecological effects.
Vermeissen, Ecotax Centre Eawag-EPFL / Aquatic Ecotoxicology; D. Olbrich, Swiss Centre for Applied Ecotoxicology EAWAG - EPFL; L. Werner, Ecotax Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; E. Simon, Centre Ecotax / Aquatic Ecotoxicology

Many in vitro bioassays are run on 96-well plates and typically, reference compounds, standards and samples are added to the wells of a plate using solvents (e.g. ethanol). These solvents are then evaporated, media with cells are added to the assay and the test compounds are dissolved and made available to cells in the bioassay. However, there is scant information on the kinetics of the redivisibility of test substances on 96-well plates. Furthermore, a redissolving step can be circumvented by adding samples and standards directly to the assay, either dissolved in water or medium (or DMSO). In this study we compared the availability of four estrogenic compounds (E2, E1, E2 and BPA) on 96-well plates in the lyticase-based yeast estrogen screen assay (LYES; this test was recently adopted as an ISO standard). Two-fold dilution series of compounds were added directly to the wells via medium (aqueous; i.e. as suggested in the LYES ISO protocol) or using ethanol (ethanolic) which was evaporated before medium was added. We tested different redissolving times by shaking the plates, using shaking times between 0 to 120 min. After redissolution medium was transferred to new wells for further testing (redissolved) and emptied wells were given fresh assay medium and yeast cells and were also tested (rest). We evaluated the recovery of test substances in “redissolved” and “rest” wells. Results revealed that, for all test substances: 1) less activity was observed after ethanolic application compared to aqueous application, while their relative potency towards the reference substance remained the same; 2) contribution. Several studies have indicated acute effects of chemicals causing changes in DNA fragments such as micronuclei in the cytoplasm of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (Mytilus galloprovincialis). According to our results MN frequency of 10 stations varied between %39.33 - %5.60 and Binucleate cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. Key Words: Izmir Bay, Pollution, micronucleus, Mytilus galloprovincialis

TH222 Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment

TH222 Mutagenic and ontogenetic responses in freshwater guppy Poecilia vivipara chronically exposed to waterborne sodium dodecyl sulfate (SDS)

L.C. Penha, Federal University of Maranhão - UFMA / Departamento de Ciências Biológicas; D.B. Boaes, Federal University of Maranhão - UFMA / Instituto de Ciências do Mar-ICMar; M. Jorge, Universidade Federal Maranhão - UFMA / Instituto de Ciências do Mar-ICMar; G. Santos, Federal University of Maranhão - UFMA / Instituto de Ciências do Mar-ICMar

The deposition and persistence of some chemicals in aquatic environments is a constant threat to aquatic organisms. Sodium dodecyl sulfate (SDS) is a surfactant widely used as an emulsifier in household products and is constantly present in the environment in small concentrations. Several studies have indicated acute effects of high SDS concentrations on animals’ behavioral, reproduction and cell division. However, little is known about chronic effects of SDS in aquatic animals. Thus, the present study evaluated the mutagenic (nuclear abnormalities) and ontogenetic (embryo formation) responses in freshwater pregnant female of guppy Poecilia vivipara chronically exposed (90 days) to waterborne sodium dodecyl sulfate (0.3 and 3.0 mg/L). The groups were maintained for four weeks, and the experiments were conducted in a flow-through system under controlled conditions. After exposure, females’ blood was analyzed for nuclear abnormalities (micronucleated cells, nucleated blastodeum and nucleated blastodeum cells with cells presenting apoptotic fragments), and non-parity females were submitted to cesarean section for embryo classification of development stage (less developed until completed newborn fish). The results demonstrated that there were no external deformities in the newborn fish during the exposure. However, there was a decrease in the number of fry on the females exposed to both concentrations of SDS in relation to the control, as well a delay in the development of the embryos of the exposed females, indicating ontogenetic effects even at low concentrations of SDS (0.3 mg/L). Regarding the nuclear abnormalities, both SDS concentration caused significant increments in the frequency of all abnormalities when compared to the control group (p<0.01). The major concern about nuclear abnormalities in the permanent damage they can cause and the consequently genotoxic and mutagenic damages. These results indicate that freshwater Poecilia vivipara chronically exposed to SDS does not appear to be protected by European Directive (73/405/EC) that allowing the concentration of 0.5 mg/L of anionic surfactants (such as SDS) in drinking water and 1 mg/L in the freshwater used for other purposes.

TH221 DETERMINATION OF IZMIR BAY POLLUTION BY USING GENETIC BIOMARKERS IN THE MUSSEL (MYTILUS GALLOPROVINCIALIS) TAKEN FROM THE NATURAL ENVIRONMENT

A. Aksel Arslan, University Ege / Hydrobiology; H. Parlak, Ege University; M. Boyacioglu, Ege University; M.A. Karaaslan, University of Ege; G. Gilsiever, Ege University

Izmir Bay, which is surrounded by many agricultural and industrialized cities like İzmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were effectivated very badly due to much kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and redging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were unbearable in 1980. As all the city smell very badly. Micronuclei (MN) tests is a system of micronucleus testing used to test the genotoxicity of pollutants. We were evaluated the in vivo/MN-tests and the changes in DNA fragments such as micronuclei in the cytoplasm of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (Mytilus galloprovincialis). According to our results MN frequency of 10 stations varied between %39.33 - %5.60 and Binucleate cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. Key Words: Izmir Bay, Pollution, micronucleus, Mytilus galloprovincialis
Effect of thermal stress on endocrine disruption in Daphnia magna J. Na, Korea University; H. IM, J. Jung, Korea University / Environmental Science and Ecological Engineering

Endocrine disrupting chemicals (EDCs) include various types of natural (17β-estradiol, estrone) and synthetic (nonylphenol, bisphenol-A) compounds presenting inhibition or mimicking of the reproductive action of endocrine system in vertebrates and invertebrates. Recently, several studies reported that daphnid species which reproduce by parthenogenesis may generate males in response to EDCs. In addition, it was demonstrated that variation of water temperature is able to change reproduction, growth, and survival of aquatic organisms and population number. This study aims to evaluate the effect of thermal stress on endocrine disrupting effect of EDCs using Daphnia magna. Short-term screening (STS) assay was performed to determine the endocrine disruption effects using adult (10-17 days old) daphnids. Animals were exposed to two temperatures of 20°C and 25°C, and reproduction, growth, male production and survival rates were evaluated. This study can give an insight into the endocrine disrupting effects of EDCs on aquatic organisms under influence of thermal effluents discharged into streams and rivers.


The development of new chemical compounds is a long and costly process that may span up to 10 years. However, the success rate of new chemical families has decreased exponentially in the last decades mainly due to compounds toxicity detected in later phases of the R&D process. The OECD publishes a series of guidelines to define the toxicity evaluation assays required for regulatory purposes. The 201 guidelines, in particular, describes the alga growth inhibition test for the evaluation of aquatic toxicity. Nevertheless, the procedure is tedious and time-consuming, so it’s not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for new fast and cost-effective assays with an increased throughput to assess the aquatic toxicity of a compound in early phases of the development. In this work, we present a miniaturized version of the OECD 201 algae growth inhibition test. The miniaturized test is carried out in 96 well plates and the biomass measurement is performed on a plate reader. The methodology makes possible to test ten concentrations of a compound and a negative control on the same plate. The biomass measurement by fluorescence readout is a sensitive and reproducible measurement of alga concentration in an efficient manner, with a significant time and human labor reduction. The alga microplate assay was validated with environmentally relevant reference compounds (such as pesticides or flame retardants) and the resulting IC₅₀ values were compared to the OECD 201 results.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy (P)

TH226 Applying Social-LCA and Social Hot Spot Analysis including a SDG Evaluation to Product Assessments with SEEBALANCE® P. Salino, BASF SE / Sustainability Strategy; A. Alba Perez, T. Gruenenwald, P. Saling, BASF SE / CDS/S

Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed by the SDGs (Sustainable Development Goals). For this reason, social aspects also have an increasing impact on marketing and management decision-making processes. In The SEEBALANCE® methodology, measures the ecological and economic consequences of alternate products or processes. The Eco-Efficiency Analysis is integrated to an overall result together with the Social Analysis (Figure 1).

TH227 Pilot Responsible Research and Innovation in Industry E. Yaghmaei, I. Van de Poel, Delft University of Technology / Values, Technology & Innovation; A. Porcir, Arii - Italian Association for Industrial Research; E. Mantovani, E. Borsella, Italian Association for Industrial Research

There is now only limited experience with Responsible Research and Innovation (RRI) in industry and there is also limited evidence of the added value of opening up the innovation process in industry for social engagement and gender considerations. In the PRISMA project (http://www.rri-prisma.eu), we overcome these current limitations by carrying out eight RRI pilot projects in a real-world industrial context. To establish the added value of the RRI approach and the gender dimension in and for industry, we assess the pilot projects on a number of product and process RRI dimensions and compare the pilots on the relevant RRI dimensions with similar projects in the same companies in which the RRI approach has not been followed. We focus on implementing RRI for some of the major technological challenges in the EU including nanotechnology, synthetic biology, Internet of Things (IoT) and self-driving or automated cars.

TH228 Sustainable Guar Initiative - an integrated approach of social and environmental LCA P. Martz, LOreal Research & Innovation / LORAL; P. Arsac, N. Zaaraoui, LOREAL; A. Wahelet, Solvay SA / LCA; J. Viot, F. Laurent, Solvay SA; M. Vuillat, S. Causee, EVEA

Sustainable Guar Initiative (SGI) is a three-year long integrated program aiming at developing sustainable guar production within the Bikaner district in Rajasthan, India. This desert district is one of the largest producers of guar and guar gum in India. SGI was set up by Solvay, L’Oréal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutral approaches and best practices in guar farming, along with tree plantation, (3) Social impact: gender approaches, nutrition, health & hygiene and (4) Market improvement: traceability, supply chain and market access. Guar gum is extracted from guar seed and can be used as such, or functionalized. It is for example used as a bio-based thickening agent in personal care products. To confirm and consolidate the relevance of the program and to identify potential improvement opportunities, an environmental and social Life Cycle Assessment (LCA) has been conducted, comparing the guar production before and after the SGI. The social LCA has been conducted following already available guidelines, including UNEP-SETAC Guidelines for Social Life Cycle Assessment of Products and WBCSD Social Life Cycle Metrics for Chemical Products. Methodological developments have furthermore been undertaken in order to fully take into account the smallholders. The Master’s thesis of Dhingra, P. “Integrating Smallholders within the Handbook for Product Social Impact Assessments” has been completed with some developments, related to: (1) Goal and scope: better identification of relevant stakeholders and social aspects, (2) Inventory: improvement of data quality among the social aspects, stakeholders or life cycle steps and (3) Performance assessment: common rating system enabling aggregation related to inventory from multiple sources. Besides environmental LCA, the poster will focus on social LCA. Methodological challenges encountered will be presented and solutions to tackle them will be detailed as long with other limits related to these new developments.

TH229 How can the social pillar can be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study P. Falcone, E. Imbert, A. Tani, V. Tartiu, P. Morone, Unitelma Sapienza University of Rome

Abstract Along with environmental and economic assessment, social sustainability of the bioeconomy have become a growing challenge, with important effects in many aspects of the market uptake of bio-based products. In recent years social and socioeconomic aspects have progressively been included in both the discourses and sustainability analyses concerning the bioeconomy. Yet, when it comes to bio-based products the situation still lags behind (Siebert et al. 2017[1]), given that bio-based products involve longer and more complex value chains (Bell et al. 2014[2]) that make the assessment of social and socio-economic impacts extremely challenging. Furthermore, the success of a sustainable bioeconomy depends on stakeholders’ acceptance – especially consumers and manufacturers – leading to a growth in demand for such products. The choice of “what is to be measured” is the critical point in S-LCA, and, by employing recognised participative techniques, the stakeholders’ involvement can be used to shape the final sustainability criteria and regulatory recommendations. Against this background, our study aims at investigating to the social dimension of the transition towards bio-based products, by identifying and validating the main social impact categories pertaining to the bio-based products realm. In doing so, we employ a robust three-step methodological framework encompassing: impact categories identification, stakeholders mapping, and social impact categories validation. In order to operationalize the methodological framework, empirical data is gathered by means of in-depth literature review, stakeholders’ interviews, and focus groups. By providing empirical evidence on the social dimension, which incorporates different visions of the stakeholders involved in the bio-based value chains, our study paves the way for further developments concerning the integration of social assessments within bioeconomy context. Keywords: bio-based products, social assessment, stakeholders analysis - bio-based products - social dimension - S-LCA

TH230 Methodological considerations for applying social LCA to modelled future European energy systems in the REFLEX project N. Brown, KTH royal Institute of Technology / Sustainable Development, Environmental Science and Technology; E. Ekener, KTH royal Institute of Technology; M. Fuss, KIT Karlsruhe Institute of Technology / Institute for Technology Assessment and Systems Analysis ITAS; L. Xu, KIT Karlsruhe Institute of Technology

A methodology has been developed for the social assessment from a life cycle perspective of supply chains for future energy systems for the European Union
Concerning the oil Environment, Land and Sea; M. Orrù, National Center for Chemical Substances

TH232

Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international organisations. Authors: Serena Santoro – National Research Council (CNR) - Institute of Atmospheric Pollution Research Italian Ministry of the Environment, Land and Sea Silvia Giardina – Italian Ministry of the Environment, Land and Sea – General Directorate for environmental assessments and authorisations Marianna Antonietta Orri – National Institute of Health - National Center for Chemical Substances Debora Romoli - Italian National Institute for Environmental Protection and Research.

TH233


In Europe and in the context of Regulation (EC) 1107/2009 for placing into the market of plant protection products rice as a crop is an anomaly and has created several difficulties in its evaluation. For regulators, there is a need for comprehension of the unique agronomic practices, application techniques, water management and environmental concerns, both from an ecotoxicology and environmental fate perspective considering the majority of rice cultivated within the Europe is grown in paddy fields. This gap in knowledge caused issues in the evaluation of rice as a representative use in the process of European authorization of active substances for plant protection products and raised questions over the suitability of environmental indicator species and risk assessments within the context necessary. Rice is a major crop in many Southern Zone Countries and the difficulties gaining an understanding of rice practices, compounded by uncertainty with changing regulatory requirements and a lack of transparency in evaluation procedures has hampered the process of active substances approval. Such a complex framework could dissuade active substance renewal by agrochemical manufactures or indeed inhibit innovation. In conjunction, an increase in weed resistance to plant protection products currently available has forced Member States to continually rely on Emergency Uses Permit year on year to support the rice growing community. Weed and pest tolerance to agrochemicals is increasing across European countries, in conjunction with the lack of technical tools available for weed and pest control. Rice farmers recognise the urgent need for active substances to be placed on the market with different modes of action to combat resistance and safeguard the production. The above mentioned topics have been deeply discussed among experts of different disciplines from the rice producing European Countries in an ad hoc workshop facilitated by Dow AgroSciences in July 2017. The outcome of the discussion highlighted the need for a bottom-up multidisciplinary approach, with farmers, local networks, users and research institutes facilitating an environment to coordinate a strategy for implementation, with a Member State authority championing this venture through zonal steering groups. The main conclusions of the workshop will be presented and discussed in the poster.
Norwegian Institute for Water Research; B. Grovik, Institute of Marine Research; E. Lyng, International Research Institute of Stavanger; R.C. Sandt, Statoil Oil and gas companies operating on the Norwegian Continental Shelf (NCS) are required to carry out environmental monitoring to obtain information on the actual and potential environmental impacts of their activities and to give authorities a better basis for regulation. Scientists, operators and regulators have worked jointly for the last two decades in this program, for developing, communicating and implementing knowledge, methods and tools to manage the offshore produced water discharges. A multidisciplinary approach (e.g. chemistry, biology, modelling and risk assessment) has been developed to monitor the discharge and reduce risk. Potential impacts from no-targeted chemicals have also been in the aim of this extensive monitoring program for anticipating negative effects at the ecosystem level. In 2015, new guidelines as result of the experience performed since 1995. The new requirements have been applied for the first time in the 2017 Water Column Monitoring program. This holistic approach shows a significant improvement in the scientific outcomes of the monitoring, in a cost-efficient way. The surveys included the use of species from various trophic levels and the analysis of both chemical and biological parameters. Three regions were selected: Tampen, Southern Norwegian Sea and Egersundbanken (reference area) and in addition the near platform effect (Stafrid A) was assessed. The study design included the use of a predictive discharge model (Dose-related Risk and Effect Assessment Model, DREAM). This model calculates the fate of the discharge in 4 dimensions (including time) to predict environmental concentrations, risk and effects. Biological and chemical data confirmed the accuracy of the study design and predicted risks. These implications can be used to be the basis for the recession of risk in the ecosystem. Data showed a general decrease in the actual impact in comparison to previous years. This is a great achievement, that demonstrates the importance of collaboration between researchers, operators and regulators. It is worthwhile to notice that while developing the Water Column Monitoring program, scientists in Norway prioritise a RRI (Responsible Research and Innovation) approach.

TH235

DAPHNE: a supporting tool for pesticides risk assessors and stakeholders
A. Liguonado, F. Galimberti, S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; L. Menaballi, ICPS International Centre for Pesticides and Health Risk Prevention; S. Ullucci, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health
DAPHNE (DAtes and PHenological Estimation) is a tool created to contribute supporting the Environmental Risk Assessment (ERA) of pesticides. The rationale behind its development is based on correlating crop phenological stages (BBCH) to specific dates for representative geographic areas is often a crucial step both for the exposure and (higher tier) effects assessment. However, currently there is no source of information clearly addressing this issue at the national, zonal or EU scale. Data from a number of field efficacy trials were collected in a database that could realistically represent reference scenarios and typical Italian crops. These data included information on BBCH and related date, agronomic and pedoclimatic conditions. The dataset was primarily used to extrapolate BBCH vs date curves for selected crops. These information can be used to be the basis for the design of uncertainty in both exposure and ecotoxicological higher tiers effect evaluation. Among the potential applications, correlating dates and BBCH would help to: harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off; provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged.

TH236

The applicability of the assessment entity concept in the REACH registration of complex mixtures. A case study for fragrance substances.
K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Kreutzer, Givaudan SA; S. Kern, Givaudan Schweiz AG; M. Pacella, M. Torres Sanchez, Givaudan Suisse SA
The assessment entity (AE) concept was developed by ECHA together with industry and independent experts in an ad-hoc expert committee. The tool was introduced in IUCLID 6 and aims to assist users in documenting complex assessment cases in a transparent and systematic way. The assessment entities (AEs) may be imported in Chesar 3 for the purpose of exposure assessment. The relevance and applicability of the AE concept to multi-constituent substances is illustrated by a fragrance ingredient case study. For the purpose of the worker and consumer risk assessment, the traditional whole substance approach was used. However, to assess environmental exposure and risk, a constituent block approach was used because the substance consists of components with different environmental fate properties (e.g. water solubility, log Kow, adsorption coefficient) and ecotoxicity profiles (e.g. acute EC50/LC50 values). The use of whole substance testing versus constituent data is explored. The adaptation of standard tests, such as that of the traditional whole substance, will be shown, showing how the different HPLC partitioning characteristics of the components and the use of two analytical detection methods was exploited to obtain water solubility information for the individual blocks from a test performed on the whole substance.

The case study also demonstrates the combined applicability of experimental data, QSAR and read-across in the assessment of the aquatic toxicity of the individual constituents and impurities in order to derive appropriate PNECs for each assessment entity.

TH237

Canada's Approach to Determining Causes of Impairment at Federal Contaminated Sites
M.H. Henning, D. Pelletier, Ramboll EH; M.T. Sorensen, Ramboll / Senior Science Advisor

Canada's Federal Contaminated Sites Action Plan (FCSAP) was developed to reduce risks to human health and the environment from--and to reduce the financial liability associated with--contaminated sites. A key element of FCSAP is the common use of ecological risk assessment (ERA) as a site management tool, a Focus Group developed guidance for conducting ERAs under FCSAP. One element of that guidance is a technical guidance module on conducting causality assessment. Causality assessment has the overarching goal of differentiating ecological impairment due to chemical stressors from natural variability and from impairment due to other stressors, such as biological and physical stressors. Costly remediation and litigation decisions often hinge on an assumption of causality. It is therefore essential that ERAs objectively examine all plausible causes of observed impairment and attempt to establish cause-and-effect relationships between stressors and responses. The FCSAP causality assessment framework is based on U.S. Environmental Protection Agency's CADDIS guidance, though it is simplified in an ecm, worst facilitates its use as FCSAP regional sites to be to populations complexity and size. The adaptable and iterative process described in the guidance module consists of four main steps: listing all candidate causes, integrating causality into study design and sampling; analyzing data for causality; and weighing the evidence on various candidate causes and drawing conclusions. Systematic analysis and documentation of the strength of evidence for and against candidate causes is a fundamental element of causality assessment. Each potential cause of impairment is transparently evaluated with respect to co-occurrence, temporality, consistency of association, biological gradient, complete exposure pathway, plausibility, specificity, and predictive performance. Multiple lines of evidence on each candidate cause are then evaluated for both consistency and coherence of evidence. The guidance and the presentation close with an overview of evidence from the peer-reviewed literature.

TH238

Improving "man via the environment" exposure assessment for lead: a case study with lead in-reach and recycling uses.

Current chemical safety assessments for metals under REACH typically include a generic, worst-case exposure assessment to limit populations resulting from exposure via the environment. As a result of comprehensive biological monitoring campaigns undertaken by European Member States in the past and supplemented modelling data, a large body of data is available on lead body burdens in the general European population (children and adults). However, little information is reported for blood lead in populations surrounding lead manufacturing facilities. Moreover, whereas lead in food and beverages is the primary expected source of exposure (with soil and dust also contributing to children’s exposure due to play habits), it is difficult to apportion the source of this lead exposure to specific uses. Under REACH authorization processes (as part of a socio-economic analysis), it becomes more important to estimate the contribution of a specific use and specific exposure pathways. Consequently, there is a need to better define the contribution of lead exposures resulting from battery manufacturing and recycling operations in the EU. This paper presents the development of conceptual model to assess risk in humans indirectly exposed to lead via the environment using a tiered approach that utilizes the European Union System for the Evaluation of Substances (EUSES) and other advanced tools such as MVE for risk assessment. As a first step, local site-specific and regional environmental exposure scenarios and assessments are updated. Next, lead specific empirical bioaccumulation and transfer factors are derived based on a comprehensive literature survey. These parameters are used to describe additional pathways missing in EUSES, such as deposition on crops and soil/dust ingestion. Such pathways have been demonstrated to be dominant sources of lead exposure in humans and thus included in a so called EUSES MVE+. Based upon the results of this EUSES-like screening exercise, higher tier approaches are developed for selected exposure pathways and/or scenarios. Ultimately the results of the environmental exposure modeling have been used in a comparison of predicted blood lead levels with biomonitoring data in the process of risk characterization and documentation as needed for REACH authorization purposes.

TH239

Validation of the industrial Simple Treat model for a site specific setting
J.C. Otte, M. Alter, A. Boehm, H. Elpel, I. Lemche, S. Pawlowski, BASF SE
The multimedia model Simple Treat is applied in the chemical legislation in Europe for decades and recently also in other legislations around the globe. It evaluates the distribution and elimination of chemicals by sewage treatment plants (STPs) in a municipal environment. It has been shown that the specific settings of industrial STPs differ largely compared to the standard settings of the municipal model of Simple Treat in terms of inter alia biological oxygen demand, hydraulic retention time, and temperature. To improve the modeled chemical fate in industrial STPs (iTreat; Straus et al. 2016, Chemosphere 159, 619-627) but failed to show site specific validation due to lack of appropriate data. Therefore, the iTreat model was parametrized to the specific parameters of an industrial STP at a specific site. Time series of measured elimination of 22 substances in the waste water stream of this specific STP were gathered and compared to the calculated elimination. The bioaccumulation rate constant of substances turned out to be a more sensitive parameter when predicting the elimination rate with either model. In detail, substances with low biodegradation rate constants (e.g. the rate constant of 0.1 h⁻¹) in the dataset showed more realistic elimination rates in the parametrized iTreat model than for the non-parametrized iTreat or the two municipal models. Compared to the municipal model of Simple Treat 3.1, the parametrized iTreat showed to two-fold higher elimination rates which reflected the measured elimination. The application of specific degradation rate constants (derived from biodegradation tests with adapted activated sludge of the respective site) for the site-specific model of iTreat will also be discussed in this poster contribution. Taken together, the validation exercise was successful and the parametrized iTreat model is applicable to other substances being produced at this site where measured data is not available.

TH241
A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.
A. Ratier, Iristea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, Université de Bordeaux; P. Labadie, UMR CNRS EPOC Université Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / UMR EPOC LPTC; N. Delorme, L. Garnero, Iristea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Iristea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Iristea / Water

Combination of remote sensing and coarse statistical data for determination of precise spatial distribution of a pesticide load onto soils at a national scale
V. Koded, Czech Hydrometeorological Institute / Section of water quality; L. Brodsky, Mapradix Ltd.; T. Herza, Hydrossoft Veleslavin Ltd.
Objective of the Study In order to calculate an annual pesticide load over a certain area, one needs detailed data on pesticides’ application that are hard to find in a real world. One way is to collect desired data from the farmers, but this is feasible just in relatively small areas. Due to missing detailed data, we computed more precise pesticide load using area-weighted methods (in the vicinity of sampling points) and maps of crops derived from a remote sensing imagery. Material and Methods Data on annual pesticide usage for 77 districts in the Czech Republic and remote sensing multispectral data (IRS AWIFS and multitemporal images Envisat MERIS, Landsat 7 – LEC, lately Landsat 8 – LDCM and Sentinel-2) together with a custom database of plant protection products used. Crop cov to 12 classes) of grids of 100 m cell size (lately 14 classes, 25 m cell size) were derived from remote sensing images; the crops were linked to plant protection products (PPP) and active substances. Then redistribution of pesticide usage from districts to grid cells was carried out using established link between a crop, PPPs and respective active substances. Results The grid of pesticide usage on perennial crops is produced before the end of spring every year in order to provide data needed for monitoring of pesticides that starts regularly in April. The grid of pesticide usage on all the other crop classes is produced regularly in November. The results are published on WWW and annually updated in order to provide water managers with information necessary for a meaningful design of pesticide monitoring in the Czech Republic. Conclusion The product provides more detailed information on a spatial load of pesticides than other publicly available data on pesticide usage and it is very welcome by interested water managers. Further advancements are planned in the future as new remote sensing sensors become available.

TH242
Bioaccumulation and biotransformation of Hexabromocyclododecane (HBCD) by the freshwater crustacean Gammarus fossarum: a Bayesian approach to estimate biodynamic model parameters.
A. Ratier, Iristea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, Université de Bordeaux; P. Labadie, UMR CNRS EPOC Université Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / UMR EPOC LPTC; N. Delorme, L. Garnero, Iristea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Iristea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Iristea / Water

Combination of remote sensing and coarse statistical data for determination of precise spatial distribution of a pesticide load onto soils at a national scale
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Objective of the Study In order to calculate an annual pesticide load over a certain area, one needs detailed data on pesticides’ application that are hard to find in a real world. One way is to collect desired data from the farmers, but this is feasible just in relatively small areas. Due to missing detailed data, we computed more precise pesticide load using area-weighted methods (in the vicinity of sampling points) and maps of crops derived from a remote sensing imagery. Material and Methods Data on annual pesticide usage for 77 districts in the Czech Republic and remote sensing multispectral data (IRS AWIFS and multitemporal images Envisat MERIS, Landsat 7 – LEC, lately Landsat 8 – LDCM and Sentinel-2) together with a custom database of plant protection products used. Crop cov to 12 classes) of grids of 100 m cell size (lately 14 classes, 25 m cell size) were derived from remote sensing images; the crops were linked to plant protection products (PPP) and active substances. Then redistribution of pesticide usage from districts to grid cells was carried out using established link between a crop, PPPs and respective active substances. Results The grid of pesticide usage on perennial crops is produced before the end of spring every year in order to provide data needed for monitoring of pesticides that starts regularly in April. The grid of pesticide usage on all the other crop classes is produced regularly in November. The results are published on WWW and annually updated in order to provide water managers with information necessary for a meaningful design of pesticide monitoring in the Czech Republic. Conclusion The product provides more detailed information on a spatial load of pesticides than other publicly available data on pesticide usage and it is very welcome by interested water managers. Further advancements are planned in the future as new remote sensing sensors become available.

TH243
Chemical Exposure Disparities by Demographic Traits in the US Population 1999-2014
V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; O. Jolliet, University of Michigan / Department of Environmental Health Sciences; A. McSharry, University of Michigan / Department of Epidemiology; T. Egan, University of Michigan / Department of Biostatistics
Identifying individuals or populations at high risk for adverse health outcomes due to chemical exposure requires understanding how chemical exposure patterns vary by inherent traits. Currently, we lack of comprehensive screening to study the thousands of chemicals populations are exposed to on a daily basis. The purpose of this study is to develop a systematic approach that quantifies chemical exposure disparities by demographic traits for a broad set of chemicals. We will identify populations at high risk for exposure. We used the National Health and Nutrition Examination Survey (NHANES) datasets to collect information on chemical biomarker measurements and demographic traits for the years 1999-2014 (n = 74,942), focusing on 229 chemical biomarkers from 16 different classes of chemicals. Poverty income ratio (PIR) was used as a surrogate variable for socioeconomic status, while cotinine levels was used as a proxy for smoking habits. We evaluated the association of each individual biomarker and various demographic factors (age, gender, race/ethnicity, PIR, and smoking status) by using generalized linear model while controlling for relevant confounders and covariates.
Our findings show that race/ethnicity, gender, and socioeconomic status can be statistically significant predictors of chemical exposure. More specifically, parabens, which are chemicals used in personal care products (PCPs), and 2,4- and 2,5-Dichlorophenol, which can be a products of photo-degradation of triclosan, a common antibacterial and antifungal agent, were observed to elevated in African Americans when compared to White Americans. In addition, higher levels of parabens among women, while men showed higher concentrations of N,N-Diethyl-meta-toluamide (DEET). This could possibly be from women using cosmetic PCPs more frequent and in larger amounts, and men using insect repellent slightly more frequently than women do. Finally, individuals of higher socioeconomic status had higher levels of benzophenone-3 (used in sunscreen products), parabens, and triclosan, which could possibly be explained by more accessibility to PCPs. In this study, we have identified inherent and demographic traits associated with elevated biomarker concentrations. We hypothesize that this is due to use patterns of consumer product, particularly PCPs. This could support research findings emphasizing the importance of near-field chemical exposures.

TH244
Occupational exposure to flame retardants among Canadian e-waste dismantlers
L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; V.H. Arrandale, Cancer Care Ontario; M.L. Diamond, University of Toronto / Department of Earth Sciences
The amount of e-waste produced globally is growing dramatically. National numbers suggest a 1.5% growth in the amount of e-waste produced annually. E-waste dismantlers working across Canada increased seven times in the period of 2002-2012 from 10,250 to 71,300 tonnes/year. One hazard associated with e-waste dismantling is flame retardants (FRs) which are added to electronic and electrical products to meet flammability standards. Little is known about exposure of workers to FRs in e-waste dismantling facilities in high-income countries such as Canada. Here, we have undertaken the first study to report on concentrations of flame retardants detected in air samples in an indoor e-waste dismantling facility in Southern Ontario, Canada, and to estimate occupational exposure of dismantlers at the facility to these FRs. Sampling was conducted daily over a total of five days in February 2017. Thirty-three dust samples were collected using vacuum cleaners and air samples were collected using polydimethylsiloxane passive air samplers (PDMS-PASs) co-deployed with active low-volume air samplers (LV-AAS). A Micro-Orifice Uniform Deposition impactor (MOUDI) was used to obtain particle size distribution of air samples. Post-deployment, samples were extracted and analysed for 12 target FRs, including novel brominated flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs) and organophosphate esters (OPEs), using gas chromatography mass spectrometry (GC-MS). The most abundant FRs in air and dust samples were the new and emerging FRs accounted for 79% of all target compounds. The median air concentrations of OPEs, PBDEs ranged from 1030 ng/m³ to 209 ng/m³. Preliminary estimates made using air concentrations measured here suggest that the total daily inhalation intake of all 12 FRs was ~17 µg/day FRs among e-waste dismantlers. Results for the MOUDI samples showed that trisphenyl phosphite (TPH) and other replacement FRs were more abundant in air and dust samples than the novel and emerging FRs. The air-oil sampling technique suggest opportunities for inhalation exposure to flame retardants among e-waste dismantlers in Southern Ontario, Canada.

TH245
Global approaches to environmental exposure assessment of e-wastes
D. Purchase, Middlesex University / Department of Natural Sciences, Faulty of Science and Technology; L. Bisschop, Erasmus University Rotterdam / Department of Chemistry; C. Ekberg, Chalmers University of Technology / Division of Energy and Materials, Department of Chemical and Chemical Engineering; P. Fedotov, Russian Academy of Sciences / Vernadskii Institute; H. Garelick, Middlesex University; N. Kandile, Ain Shams University / Department of Environmental Specimen Bank and Elemental Analysis; D. Hansknecht, Evonik Performance Materials GmbH / IME or Molecular Biology and Applied Ecology / Department of Environmental Monitoring; A. Serpe, University of Cagliari / Department of Organic and Biomolecular Chemistry; K. Surati, Sardar Patel University / Department of Chemistry; B.P. Wilson, Aalto University / Department of Chemical and Metallurgical Engineering.

Obsolete or end-of-life electrical and electronic equipment waste streams continue to grow exponentially, creating a worldwide pollution problem. E-waste comprises a heterogeneous mix of hazardous and non-hazardous metals, metalloids, glass, plastics, flame-retardants, and microplastics, which could contaminate water, soil, and sediments. In developed countries, e-waste management is resolved using two major strategies: either by internal recycling/disposal or via exportation to developing nations. For developing countries, the management of e-waste is complicated by illegal waste shipments and further exacerbated by weak environmental regulations coupled to inadequate technology and organizational structures. Rudimentary methods such as dismantling, melting, and burning are often used by the informal sector to recover valuable materials from different e-waste components. These unofficial recycling practices contribute to the release of toxic metals and persistent pollutants that affect both the environment and human health. As a result, e-waste issues are complex, multi-faceted and can only be successfully tackled via a multidisciplinary, trans-boundary approach that involves all stakeholders that include amongst others: manufacturers, scientists, economists, policy makers, waste professionals and consumers. The e-waste project “[The Environmental and Health Challenges of E-waste and its Management: an Emerging 21st Century Global Concern] (#2014-031-3-6000), supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global experts to explore different aspects of this multilevel challenge: chemical analysis of contaminants, policy and governance, environmental and health impacts, development and advances in treatment technologies including e-waste valorisation. This presentation makes use of studies from around the world to highlight the following: i) discrepancies in the implementation and enforcement of regulations between developed and emerging countries; ii) complexity in the analysis of e-waste contaminants in environmental and biological samples; and iii) lack of harmonisation of tools or indices to assess risk in environment and health, particularly in soil. It is proposed that a harmonised approach should be taken to use appropriate specification analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.
µg/L. Here an existing continuous flow analysis (CFA) method was selected using a system with a special cuvette installation allowing a higher sensitivity. The protocol was validated and accredited according to standard ISO/IEC 17025. With this system an LOQ of 0.15 µg/L can be reached under optimal conditions while an LOQ of about 0.3 µg/L is achieved during routine operation. Previous to field testing it was verified that samples can be stabilized for at least 24 h by adjusting the pH of samples between pH 12 and storing it in the dark at 4°C. Samples spiked with low concentrations of a cyanide standard were used as positive controls. The field validation results were satisfactory, confirming that the protocol is fit for purpose. Finally, samples from several sites of a small stream with low anthropogenic influences (River Lenne) were taken and analyzed. Free cyanide concentrations of up to 0.4 µg/L were detected. There were significant differences in free cyanide concentration at different sites, with levels including 8 priority substances in LOD (LOD, 1/3 of the LOQ), and downstream sampling points where free cyanide concentrations were at least 50% higher, possibly due to degraded plant biomass in the water. This first measurements revealed that background concentrations of free cyanide in the tested surface waters can be below the proposed EQS of 0.5 µg/L. However, the analysis of further parameters (e.g. geographical regions, seasonality) is necessary to create a reliable database on the range of free cyanide background levels as basis for EQS implementation.

TH249
Application of equilibrium and kinetic passive sampling method to quantify integrative chemical profile in a small river and the outflow of WWT P. Y. Zhang, H. K. Washio, J. Lau, M. K. G. Shrestha & J. van Leeuwen (France) and in situ sampling at Saclavo, Liège, Belgium, E. Funcken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Scheaffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Monitoring water quality is challenging as most of organic contaminants present at trace levels and chemical profile is fluctuating. Current legislative requirement of water management emphasizes on sampling strategy, with levels including 8 priority substances in the month monitoring for priority substances, which is efficient approach in water management. However, the capturing variable contaminant level is also critical for eco-toxicological risk assessment. The present study reports on how to exploit equilibrium and kinetic passive sampler in parallel and evaluate dynamic chemical profile in order to satisfy the regulator requirements and environmental risk assessment. Furthermore, partitioning kinetics of a range of organic contaminants toward each passive sampler type were discussed. The equilibrium sampler tends to be biased toward present chemical profile, which is rather close to instant sample, whereas kinetic sampler provides a time-weighted average concentration (Cw,avg) over the full sampling period. PDMS sheets with two different thicknesses (76 and 209 µm) as an equilibrium passive sampler were deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration (Cw,avg) of a range of target compounds was determined. In parallel, two types of polar organic chemical integrative sampler (POCIS) were selected as a kinetic passive sampler. The one is typical POCIS with Oasis HLB® sandwiched between polyethersulfone membranes and the other is modified POCIS with polytetrafluoroethylene membrane to reduce membrane sorption artefact, which has been often discussed as one of limitation of POCIS. River Ellibach and the outflow of wastewater treatment plant located south-western Germany were selected as sampling sites and duplicate passive samplers were deployed for two weeks. After sampler recovery, targeted analysis via LC-MS/MS analysis was followed. Based on earlier results, both sampler types performed well in the sampling period highlighted seasonal variations which are characteristic of some watersheds. Similarly, the presence of Norflurazon and Dimetomorph was correlated with vineyards, which is consistent with their use. Additionally, cartographic projections of the contamination levels for the 6 sampling period highlighted seasonal variations which are characteristic of some water uses.

TH250
Improvement of relationship between water pesticide contamination and land use. This study aims to show that POCIS provides more comprehensive information during a large scale deployment, and then a better correlation between water quality and urban or various agricultural land uses. A selection of 46 polar pesticides was investigated in 51 monitoring network stations of the Adour Garonne basin (SW of France). These stations were selected in function of the agrochemical pressures and the land uses, assuming different contamination profiles in the different sub-watersheds. Six sampling periods of 14-days were performed over 2016. Firstly, a low loss of POCIS (i.e. < 10%) was recorded, proving a good implementation despite the complexity of field conditions, especially for large scale deployment. Secondly, this study demonstrated that the use of POCIS can provide valuable and unprecedented knowledge about pesticide contamination of the Adour Garonne basin. With the large amount of data collected during this 1-year monitoring, correlations between the targeted pesticides and the various land uses over this large watershed (116,000 km²) could be established. For example, principal component analysis (PCA) and Spearman correlations revealed the relationships between pesticide (Metolachlor, Tebucazon...) contaminations and typical agricultural activities (corn, sunflower and wheat crops) for some sub-watersheds. Similarly, the presence of Norflurazon and Dimetomorph was correlated with vineyards, which is consistent with their use. Additionally, cartographic projections of the contamination levels for the 6 sampling period highlighted seasonal variations which are characteristic of some water uses.

TH251
Development and calibration of o-DGT for pesticides, hormones and pharmaceuticals

The sampling of micropollutants is a challenge due to their weak concentrations and their temporal variability. These last years, passive samplers have been developed with the advantage to improve the temporal representativeness by measuring “Time Weighted Average (TWA) concentrations”. For the passive sampling of moderately hydrophilic organic contaminants, Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels let in contact for 30 minutes. The concentration in each gel disk was determined over the time, allowing the calculation of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. Then obtained with the diffusion cell method are similar than those obtained by slice stacking except for ionic compounds, which also exhibited lower affinity with gels than water, in comparison to neutral compounds. The second step consisted in membrane selection, necessary to protect diffusive gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.22 µm). Finally, to evaluate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

TH252
S. Freedlander, Smithers Viscient, LLC / Environmental Fate and Metabolism; S. Rao, Gowan Company / Regulatory; K. Malekani, S. Kang, Smithers Viscient / Environmental Fate and Metabolism

Once applied to a plant, pesticide residues have the potential to move to other plant tissue via a phloem and xylem path (Fig. 1 and 2). This study focused on the translocation of a pesticide through phloem and xylem to various tomato tissues (flower, leaf, stem, and root) when applied to leaves and soil. A suspension concentration (SC) formulation was prepared with 14C radiolabeled active ingredient. The study was conducted with three groups of tomato plants. Group 1 contained tomato plants sprayed with formulation containing 14C-Active ingredient by foliar application and soil drench, respectively, in a single application at a rate of 0.50 kg a.i./ha. Leaves, stems, and flowers were harvested at 1, 2, 4, 6, and 8 weeks after application (WAP) and root tissue was harvested at 8 WAP. At each sampling interval, the collected tissues were analyzed for total radioactive residue (TRR) at 14 different radioactivities by phosphor imager analysis. The TRR in all tissue types from the soil drench group was higher than in corresponding tissues from the foliar application group. The autoradiographs of all tissue types from the soil drench group were comparatively darker than in corresponding tissues from the foliar application.
application group. Although both basipetal movement (downward from leaf application site) via phloem and acropetal movement (upward from both leaf and root application sites) via xylem were observed, results indicate the movement of radioactive residues is much faster through xylem. Select tissue samples were extracted and analyzed by HPLC-RAM, which shows that the majority of translocated radioactive residues by phloem was metabolites of the active ingredients. This conclusion of translocation of translocation during a conventional plant metabolism study can provide valuable information to further assess the potential effects of plant protection products on pollinating insects.

TH253 An Examination of Microbial Biomass in Sediments and the Impact of Seasonal Variation
K. Malekani, Smithers Viscient / Environmental Fate and Metabolism; S.P. McLaughlin, Smithers Viscient / Department of Environmental Fate; K. Campbell, Smithers Viscient / Environmental Fate
Metabolism
Microbial biomass is an important measure of the health and viability of a sediment just as it is for soils. It is also a parameter used to assess the viability of the seafloor ecosystem. The OECD 308 Guideline ‘Aerobic and Anaerobic Transformation in Aquatic Sediment Systems’ and the EPA Guideline OCSP 835.4300 ‘Aerobic Aquatic Metabolism’. Although there is no strict recommendation for the level of microbial biomass that should be contained in sediments used for testing, like there is for soils (i.e., 1% of the soil organic carbon content, OC), it is still a useful parameter to assess viability of the seafloor ecosystem. The current presentation will focus on the impact of seasonal variation on microbial biomass in sediments as determined by fumigation/extraction procedure prior to test initiation (post-handling/pretreatment), near test initiation and near test termination. The data set concerning seasonal variation will be presented, discussed and correlated to other sediment parameters, including texture, pH, and OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

TH254 Use of scanning electron microscope (SEM) in evaluation of hypopharyngeal glands development in Honey bees (Apis mellifera L.)
The hypopharyngeal glands (HPG) of Honeybees consist of many acini connected in series. They played important role in mai

TH255 Winter 0.47 0.11 Winter 0.81 0.05 Spring 0.32 1.1 Spring 0.76 0.82 Summer 0.63 0.28 Summer 0.51 0.41 Fall 0.40 0.22 Fall 0.60 0.71 late summer Additional biomass results will be presented, discussed and correlated to other sediment parameters, including texture, pH, and OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

TH256 New Mass Spectrometry Techniques for the Measurement of Persistent Organic Pollutants
P.D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Giexy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre
Recent development in the field of mass spectrometry and instrumentation has increased the amount and quality of analytical information that can be obtained from samples. In particular, dramatic increases in mass resolution have made possible unequivocal identification of contaminants even in complex mixtures and matrices. In the area of POPs analyses of PCDD/Fs and PCBs are of concern due to small concentrations that need to be quantified and the presence of a wide range of congeners even in one loamy sediment (Taunton) and one sandy sediment (Weweantic) collected during all four seasons, a two-year period produced microbial biomass values (expressed as % OC) shown below. 2016 Taunton Weweantic 2017 Taunton Weweantic Winter 0.47 0.11 Winter 0.81 0.05 Spring 0.32 1.1 Spring 0.76 0.82 Summer 0.63 0.28 Summer 0.51 0.41 Fall 0.40 0.22 Fall 0.60 0.71 late summer Additional biomass results will be presented, discussed and correlated to other sediment parameters, including texture, pH, and OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

TH257 Influence of water temperature and salinity on impact of Hazardous and Noxious Substances (HNS) in the marine environment
M. Vannoni, D. Doran, D. Thal, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards Inc; D. Blye, Environmental Standards Inc; D. Thal, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards Inc; D. Blye, Environmental Standards Inc
The analysis of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in environmental media, foods and tissues by high resolution gas chromatography-high resolution mass spectrometry (HRMS) is frequently used as the reference methodology against which other candidate analytical approaches are compared. Official methods of analysis (OMA) of the technology, employed to generate standardized data for recovery correction have been established in the EU, the USA, Japan and other nations for decades and international standards for such methods have been established by ISO (Standards 13914 and 18073, for example). To identify achievable best practices and to understand differences in precision, accuracy and qualitative certainty for data produced from wide-ranging sources, an examination of the requirements of these methods was conducted. A review identifying critical differences and areas of agreement with regard to qualitative criteria, precision and accuracy will be presented, with perspectives on the impact differences may have on data uses by researchers conducting analyses under different protocols.
marine traffic and potentially greater risk of marine incidents.

**TH258**
Using Correlations of Biological Toxicity Equivalent Quotients and Toxicity Equivalent Quotients to Derive Threshold Values for Dioxin-Like Compounds in Sediment
D.D. Daughton, RWTH Aachen University / Department of Ecosystem Analysis; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; C. Gembé, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; G. Reifferscheid, German Federal Institute of Hydrology; H. Hollick, RWTH Aachen University / Institute for Environmental Research Sediments can act as a sink and source of pollution in aquatic environments, particularly with respect to persistent organic pollutants (POPs) which bind to sediments and then can be released into the aquatic environment if, and when, the sediments are disturbed (e.g., dredging, floods, storm events). Among POPs, dioxin-like compounds (DLCs), which consist of a variety of contaminants that share similar structures and can bind to the arylhydrocarbon receptor (AhR) in cells, are of particular concern. In addition to chemical analyses, which are often expensive and unnecessary if the contamination is low or below threshold concentrations, measurement of the induction of ethoxyresorufin-O-deethylase (EROD) activity using the rat hepatoma cell line (H4IIE) has been identified as a potential bioanalytical screening tool for the presence of DLCs in the environment. In a presented project, the biochemical component involved the use of a 96-well plate-reader–based assay to measure EROD induction with the rat hepatoma cell line H4IIE. The micro-EROD assay can be used to determine the cytochrome p450 subfamily 1a (CYP1A)-inducing potential of a variety of substances, including extracts of sediment samples. For this project, micro-EROD assays and chemical analyses were performed on extracts of 22 sediment samples collected from waterbodies in Germany. We investigated the correlation of biological toxicity equivalent quotients (BEQs) determined from H4IIE micro-EROD to toxicity equivalent quotients (TEQ) determined from chemical analysis of the sediment extracts for PCDD/Fs and DL-PCBs. Correlation analysis indicated strong significant relationships between BEQs and TEQs for PCDD/F (r²=0.940, p<0.001) and DL-PCBs (r²=0.924, p<0.001). From these correlations, threshold values can be established and the assay used as a pre-screening tool to identify samples that would require additional chemical analyses.

**TH259**
Measuring bioconcentration of cationic surfactants in fish
A. de la Torre, C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; S. Castuera, CFE, R. Carapeto García, Spanish Medicines Agency / Veterinary medicines; G. Cortés Ruíz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicine Measuring the bioaccumulation of cationic surfactants in fish is challenging. Their disposition in water depends on both pH and alkalinity. Many cationic surfactants have a tendency to sorb extensively to surfaces, making it difficult to generate and maintain constant concentrations in aquatic water. They can also sorb extensively to the surface of fish, making it difficult to separate internal exposure from external exposures. They also share similar properties to biomolecules, making it challenging to separate them from major matrix components in fish tissue samples. They can also be toxic to fish, which constrains the concentrations that fish can be exposed to. We are currently working to define the cationic surfactant property space that is amenable to measurement of bioconcentration factors in fish. We will exploit this property space to measure the bioaccumulation behaviour of a range of cationic surfactants. These data will be used to evaluate the BIONIC model, a mechanistically based model employing in vitro assay derived key input parameters (membrane-water partition coefficients and intrinsic hepatic clearance). The BIONIC model can in turn be used to estimate bioaccumulation of cationic surfactants in the property space that is amenable to measurement. Our first experiments are with a series of methyl dimethylammonium (DMA) and dimethylaminopropyl (AP) ampholytes, with a total concentration range from C9 to C16. The test chemical mixture is infused continuously into the water inflow of a flow-through aquarium using a syringe pump. To determine the concentrations of the test chemicals in aquarium water, 400 µl of aqueous water is transferred with an auto-pipette to a vial containing 600 µl of methanol, and this mixture is analysed with GC/MS/Ms. This method allows measurement of the high concentration range with a precision of 2.8%. Concentrations in the aquarium were maintained at a constant level for more than a week, whereby the ratio measured:nominal decreases with chain length. To determine the concentrations in fish tissue, methanol extracts are cleaned up on a weak cation exchange SPE column followed by large-volume injection. This method allows quantification in the low ng/g range. The results of the first bioconcentration experiments will be presented.

**TH260**
Acetylcholinesterase inhibition: a comparison of available methods for determination of acetylcholinesterase in muscle tissue of Limanda limanda.
J. Użycký, Centre for Environment, Fisheries and Aquaculture Science (Cefas) / Environmental and Animal Health Acetylcholinesterase inhibition (AChE) has been used as a biomarker of the effects of organophosphate and carbamate compounds. AChE is present in most animals and is responsible for the rapid hydrolytic degradation of the neurotransmitter acetylcholine (ACh). When AChE is inactivated by an organophosphorus or carbamate ester, the enzyme is no longer able to hydrolyse ACh and the concentration of ACh remains high. Continuous stimulation of the muscle or nerve then occurs, resulting in tetany and eventually paralysis and death. The ICES/IOC International workshop on Biological Effects of Contaminants, that took place in Bremerhaven, Germany during March 1990, provided on opportunity to test AChE inhibition as an index of marine contamination. An official ICES Technique in Marine Environmental Sciences (TIMES No.22 Biological effects of contaminants: Cholinesterase inhibition by organophosphate and carbamate compounds) is available and recommended for contaminant monitoring programmes in the marine environment. This method was published to improve and standardise the comparability between results from different laboratories and/or countries. However, the method has not been updated since 1998 and does not provide enough details on different marine species, preparation and handling of samples or storage conditions. The search continues for new monitoring tools, improvement and harmonisation of existing methods, which may be used as specific markers for contaminant effects on the marine environment. For a reliable and evidence-based risk assessment to be possible, there is a need for a more detailed and accurate guideline. This should help to obtain precise, consistent and comparable results across the national and international laboratories and therefore provide a real evaluation of the status of the marine environment.

**TH261**
Environmental emission to surface water for analogous exposure path. A reflection on the matter for biocides, human and veterinary medicines.
A. Haro-Castuera, R. Carapeto García, Spanish Medicines Agency / Veterinary medicines; G. Cortés Ruíz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicine One emission has happened for one active substance the chain of events affecting the Environment follows its path. But how we study them depends upon the approach, dictated by legislative frames, subsequent guidance and, eventually, inertia and tradition. One remarkable example is the case of insecticides. While sharing the same active substance, different products authorized under different regulation can be applied differently. Then, to be marketed, scientific evidence of safety is mandatory. For a correct risk assessment, the exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (P)

**TH263**
Using microarthropod community assays in metal mixture testing
J. Renaud, CFE - Centre for Functional Ecology; T. Nata da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; S. Siciliano, University of Saskatchewan / Department of Soil Science; J. Sousa, University of Coimbra / Department of Life Sciences Due of anthropogenic activities metal contaminated sites are a constant environmental concern and because of the persistence of these metal elements, will continue to be a pressing issue for many years to come. In terms of legislation and environmental risk assessment, much effort has been undertaken to understand the effects of metals and, more recently, the effects of metal mixtures. However, most legislation still focuses on single metal elements, disregarding mixtures. Similarly, research has been predominantly focused on single metals while mixture studies have mostly focused on binary and tertiary mixtures to determine metal interactions and to test the potential for increased ecotoxicological effects. The high number of metal combinations and the lack of established methodologies has hindered the advancement in the field of metal mixture toxicity. This study presents the effect of complex five element metal mixture ratios (Pb, Cu, Ni, Zn, Co) using a natural soil microarthropod community. These metal mixture ratios were selected based on environmental and legislative relevancy, two ratios

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produced from guideline values (Canadian soil quality guideline and EU REACH PNEC values) and a ratio based on the average concentrations in a contaminated site (Sudbury) for each metal. Each mixture was tested with 11 doses in toxic units estimated from Folosoma candida reproduction EC50 for each metal in the mixture. The community results from this experiment were transformed to similarity matrices using the Bray-Curtis coefficient and used to calculate dose response curves. This approach assumes that community changes are promoted by increasing mixture concentration. These community dose response curves allowed estimation of microthreadopod community EC values, which provide valuable insight on the adequacy of current guideline values and in developing site-specific risk assessments and remedial goals with community endpoints. Produced EC values from this simplified community experiment are currently under validation in a terrestrial model ecosystem experiment, for these same mixtures.

TH264
Alteration of stress-related and thyroid hormone related genes in zebrafish larvae after the administrations of lead acetate, and mixtures of lead acetate and BDE-209
K. Chan, The Chinese University of Hong Kong / Life Sciences; C. Leung, The Chinese University of Hong Kong / School of Life Sciences; Z. Zhou, J. Yang, The Chinese University of Hong Kong / School of Life Science
The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, cc, cat, gr, gst), and thyroid-related genes (trt, trf, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae exposure. The result of both stress-related and thyroid-related genes expression showed that lead acetate exposure induced oxidative stress-related genes. The expression profile of trt, trf, dio1, dio2, nis, sult1-st, sult1-st2, sult1-st3, uglub, ugal2, and the above oxidative stress-related genes, was also studied to unveil the impacts of co-exposure of lead acetate and BDE-209 on thyroid hormone metabolism and oxidative stress balance. Transcripts of gr and gst were induced upon both individual exposures and co-exposure, suggesting that lead acetate and BDE-209 should be considered as a single complex oxidative stress balance. No synergistic effects of the two chemicals at short time (48 hr) exposure to induce oxidative stress, while the possibility of these two chemicals acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH265
Assessment of the toxic interaction of lanthanides on aquatic organisms
A. Romero, Université de Lorraine / LIEC, CNRS, UMR 7360, Université de Lorraine, Campus Brindou, Bâtiment IBISE, 8 rue du General Delestraeart, 57070, Metz, France; E. Joonas, M. Muna, National Institute of Chemical Physics and Biophysics; D. A. Vignati, CNRS / LIEC UMR7360; L. Giamburini, Université de Lorraine, CNRS UMR 7360 / LIEC, CNRS
The relevance of lanthanides (LNs), in agricultural, industrial and, especially in high-tech applications has increased in the last decades. As consequence, more LNs are expected to enter into the environment and accumulate in the ecosystem. Although no great accumulations have so far been recorded, alterations in the Ln nature and concentrations of soils and water, have been observed and the Ln toxicity focuses on the effect of single elements, however they are commonly found as a group in nature. LNs are expected to have cumulative toxic effects on organisms, owing to their similar chemical properties, but studies as mixtures, more representative of real scenarios, are required to support this hypothesis. In this research, we evaluated the toxic interactions of binary and ternary mixtures of complexes of Ln with both organic and inorganic ligands, with particular focus on the Ln toxicity of the mixtures. From the seven organism studied (A. fisheri, R. subcapitata, C. vulgaris, B. calcitronis, H. incongruens, D. magna and D. rerio) potential toxic effects were observed only in five; and the inhibitory LN effects were strongly concentration-dependent only for A. fisheri, R. subcapitata and B. calcitronis. Bioavailable LN concentrations significantly decreased during all tests and the major decline took place at the beginning of the tests, but the extent of the decrease varied across test media. Thermodynamic speciation calculation highlighted important differences: in distilled water and 1 % NaCl, LNs were predicted to occur mainly as free ions; in more complex media, LNs appeared as free forms and with coordination numbers lower but these species were non-labile in the toxic radii, and, in detriment of these complexes, species with LNCO4- and LNI(OH)2+ groups increased. The two multi-toxicity approaches used in this study (concentration addition and toxic unit calculation) showed more than additive effect for the mixtures to the bacterium A. fisheri and the algae R. subcapitata; whereas less than additive toxicity was instead observed for the rotifer B. calcitronis. Overall, such limitations highlight that it should not be assumed LN toxicity is additive as so far, and predicting the response of aquatic organisms exposed to mixtures should be further research to better understand their toxic interactions in real scenarios.

TH266
Predicting the chemical and biological effects of tertiary metal mixture (Ni, Cu, Cd) to aquatic plant, Lemma gibba under different dissolved organic carbon concentrations
S. Martinez, CONICET PRIET UNLU; Y. Gopalapillai, Environment and Climate Change Canada; M. Saenz, PRIET CONICET, National University of Luján; B. Hale, School of Environmental Sciences, University of Guelph, W.D. De Martino, CONICET-PRIET / PRIET
Toxic effects of single metals on aquatic environments are well established. In nature, organisms are exposed to a mixture of them at different bioavailability conditions. However, this situation is not always well studied. Here Lemma gibba were exposed to Ni, Cd and Zn individually and as ternary mixtures. The influence in the uptake and toxicity of dissolved organic carbon (DOC) as an environmental light was studied. Two sets of tests were performed 0.5 mg/L and 10 mg/L of DOC. The metal concentrations at the mixture tests were chosen by an incomplete factorial design, resulting in controls plus 20 tests cases. From number inhibition (%FIN) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [M1] and external dose [M1] were conducted for all chronic studies. As total metal toxicity thresholds values were obtained for the three metals, resulting %RGI a more sensitive endpoint than %FIN in all cases. For the test with 0.5 mg DOC/L, Cd presented the higher toxicity, based on %RGI when concentration expressed as M1 = 20.8 µg/L being 10 times more toxic than Ni and 26 times than Zn. When concentration expressed as M1 = Cd was the most toxic when dose expressed as M1, but Cd when expressed as M1 was the most toxic at the end of assays, for both DOC concentrations, [Cd1]. [Ni1] and [Zn1] were higher in the single metal exposure compared to the mixtures. For the mixtures exposures, the %RGI responses ranged from 17 to 94 % in the lower DOC concentration test and from 15 to 97 % in the higher. Concentration addition (CA) model for the mixtures’ toxicity, the combinations of concentrations were used to calculate the ‘sum of toxic units’ (CTU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH267
ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA IN SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA
O. Otojou, federal University Wukari / Department of Biochemistry; T. Silas, federal University Wukari; A. Martins, S. Asemave, federal University Wukari / Biochemistry
Incidence of soil contamination by heavy metals is widely increasing with the spread of industries. Artefacts such as tea cups, ash and other waste from Mambilla Plateau have been on the increase in recent years. Therefore, the present study was aimed at characterizing and determining resistance to lead, mercury and copper by selected bacteria strains isolated in soil from Mambilla Plateau artisanal mine and to explore their bioremediation capacity. Bacteria were isolated from soil samples obtained from different locations at the Mambilla artisanal mining site. Nine (9) bacterial isolates were selected through gram-stain analysis and were used to fit the observed metal mixture toxicity data to either M1 or M2. The concentrations of the three metals in mixture expected to result in 50% RGI or FNI were calculated by solving the regression for Cd while holding the concentrations of Ni and Zn constant for each of the 20 cases. To determine whether CA was the appropriate model for the mixtures’ toxicity, the combinations of concentrations were used to calculate the ‘sum of toxic units’ (CTU). Deviations from CA approach were observed as relative results according with the metal under analysis.
guidelines for surface waters, in order to reach a good ecological water quality status for all water bodies. Nevertheless, many rivers and streams are still experiencing trace metal concentrations that exceed the current Environmental Quality Standards (EQS). In combination with other stressors, this situation may lead to an unfavorable shift in the composition of the ecological community due to a variety of direct and indirect effects. The range of concomitant contributing processes might lead to a change in the way in which aquatic environment and community will respond to the presence of a stressor(s). To gain insights into the contributing factors, we are investigating eleven sites for which apparently contradictory effects are observed. That is, based on monitoring data (www.vmm.be/geoview) gathered by the Flanders Environment Agency (VMM), the sites that have an exceedance of the EQS, yet a good ecological quality is observed despite the presence of non-polluted waters. The reason for this might be the occurrence of toxic effects mediated by the environmental change. We hypothesize that the macroinvertebrate communities at these locations have (i) adapted to high trace metal concentrations and/or (ii) experienced a lower metal bioavailability due to the water chemistry. To sort out the involved processes, we will systematically characterize the bioaccumulation and exposure patterns of trace metals in a suite of macroinvertebrate taxa collected at these sites and determine the trace metal concentrations in the different ecological compartments (water, sediment and biota). The results, together with general water quality parameters (pH, conductivity, temperature, DOC and macronutrients) will identify whether the ecological quality is primarily governed by chemical or biological factors, or a combination of the two. The outcomes of our research will provide mechanistic insights into the determinants of ecological quality and facilitate development of a more differentiated basis for the setting of EQS.

TH269
Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio
G. Casajus, University of Antwerp / Biology; G. De Broeck, University of Antwerp / Department of Biology and Environment (SPHERE Research Group)

The aquatic environment is continuously under threat because it is the final receptor and sink of waste streams. This environment receives a huge number of different compounds including heavy metals that can harm the health of aquatic organisms. The main goal of the present study is to better understand the effects of waterborne heavy metals and their mixtures on a freshwater fish. Common carp were exposed to sub-lethal concentrations of Cu and Zn and different combinations thereof for a period of one week at a temperature of 20°C. Our aim is to assess the effect of sub-lethal concentrations of Cu and Zn on fish survival rate, determine the bioaccumulation of heavy metal in the gills and assess changes in gene expression of cells exposed to these conditions. Preliminary results indicate that metal accumulation induced expression of metal binding and stress proteins, and metal specific compensatory effects were seen in genes related to ionoregulation and oxidative stress. Further analysis will determine whether antagonistic, additive or synergistic effects occurred.

TH270
Silver nanoparticles exposure inhibits glycans synthesis and induces cytotoxicity in human cell line
K. Shimizu, Toyo University; M. Horie, Advanced Industrial Science and Technology; S. Kashiwada, Toyo University / Graduate School of Life Sciences

Silver nanoparticles (SNPs) are used in industrial products worldwide. Hence, there are concerns about their potential pollution risk. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycans are one of the toxic targets of silver nanocolloids (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycans function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. In this study, we employed four different SNPs including SNCs to compare their different toxicities using three human cell lines. Of SNPs, one was coated with sulfur and diameter was ca. 30 nm. Another one’s coating material and diameter are unknown. Of SNCs, one SNCs was non-coated and its diameter was ca. 30 nm. The other SNCs was coated with nitrogen and diameter is ca. 20 nm. We used three kinds of human cell lines; lung cancer-derived A549, epidermal-derived HaCaT, and monocyte-derived THP-1 because we supposed SNPs have a chance to contact to alveolus of lungs, epidermis and blood. To evaluate cytotoxicity, each cells were exposed to SNPs or SNCs (10 µg/mL) and incubated for 24 hours, and then we measured survival rate, membrane damage, inflammatory response, ROS accumulation, caspase-3 induction, intracellular ion concentration, and gene expression. In results, SNPs suppressed survival rates. SNPs and SNCs exposures exhibited membrane disturbance and inflammatory response. However, ROS accumulation and caspase-3 induction were observed in only SNCs exposure. Measurement of concentration of intracellular silver found that higher silver concentration in SNCs exposure rather than SNPs exposure. Finally, to investigate effects of SNP/SNC exposure on glycans, we measured glycan-relates gene (ALG2, BAGAL2 and TNS) expressions. Tested gene expression levels were all suppressed by SNPs and SNCs exposures. Since this study demonstrated that SNPs inhibited glycan synthesis in medaka in vivo and human in vitro models, toxic effects of SNPs on glycan is probably universal among vertebrate organisms.

TH271
Mixture toxicity of ZnO and silver nitrate to Daphnia magna
M. Baek, KIST Europe; Y. Seol, University of Science and Technology; H. Kwon, Y. Kim, KIST Europe / Environmental Safety Group

Zinc oxide nanoparticles (ZnO NPs) and silver nanoparticles (AgNPs) as Engineered nanomaterials (ENMs) can be mainly found in numerous materials or consumer products. These applications of metal (oxide)- nanoparticles indicate that AgNPs are commonly released into the aquatic environment may lead to mixture forms of by biological system. In this study, the acute toxicity tests using Daphnia magna were conducted for examining the single- and mixture toxicity. The methodological approaches for mixture toxicity (Mixture I – 5:5; Mixture II – 7:3 and Mixture III – 3:7) were conducted as three binary mixtures of AgNO3 and ZnO based on the estimated toxicity data (i.e., EC50 values) of single substance. To compare with control response and mixture results, the mode of action in mixtures, the effects of mixture were analyzed using the MIXTOX models. The EC50 values of AgNO3 and ZnO were 0.0009 mg/L (with a 95% CI of 0.0007-0.0011 mg/L) and 2.2884 mg/L (with a 95% CI of 1.3702-2.2066 mg/L), respectively. Among the 3 mixtures, mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of all mixture of AgNO3 and ZnO, the model indicated an increased toxicity when the mixture effect was caused mainly by ZnO, and the positive b,∞ points of both model indicates a decreased toxicity (agonism) when the mixture effect was due mostly to AgNO3. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO3, MIXTOX model, nanoparticle

TH272
How relevant is mixture toxicity of herbicides in surface water?
R. Suarez, Bayer AG / Crop Science Division / Environmental Safety; A. Weyers, Bayer AG / EnSa. Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team; D. Baets, Bayer AG Crop Science Division / Sustainable Operations

The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with sub-daily sampling intervals. Mixture toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered as relatively minor. However, risks do not seem to occur for a few models indicated an increased toxicity when the mixture effect was caused mainly by AgNO3, and the positive b,∞ points of both model indicates a decreased toxicity (agonism) when the mixture effect was due mostly to AgNO3. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO3, MIXTOX model, nanoparticle

TH273
Simplify: reasonable approaches to Mixtox assessment for plant protection products
A. Weyers, Bayer AG / EnSa. Ecotoxicology; K. Bender, Bayer AG / Crop Science Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team; A. Gladbach, Bayer AG / Crop Science, Environmental Safety Assessment

A simplification strategy is needed for regulatory implementation of risk assessment of mixtures has increased and several guidance documents describe the process. Our suggestions here deal with mixtures of PPP that require an environmental risk assessment (ERA) for cumulative exposure. Depending on the regulatory context, this may include PPP with multi active substances, relevant co-formulants, adjutants, safeners or metabolites. While publications on mixture toxicity understandably tend to focus on detailed evaluations. Therefore a guiding principle in the regulatory process is that in a first tier some over-conservative assumptions can be made, if they allow to correctly identify scenarios of low risk. If formulation studies are available, the measured toxicity of the mixture (and exposure to it) should be used in ERA. When
a calculation of cumulative risk is needed based on active substance endpoints, risk indicators that have already been calculated for single substance ERA such as toxicity exposure ratios or risk quotients should be used to describe the cumulative risk. In a first simple step different endpoints, species and PECs in time and space can be mixed, to show that a given scenario is of low concern. After that first step, a mixture toxicity assessment would describe the cumulative risk more precisely at a given time and place for a defined species and the same endpoint.

TH274 Sublethal toxicity of pesticide mixtures on early life stages of non-target aquatic organisms
E. Rozmankova, RECETOX, Faculty of Science, Masaryk University / Research centre for toxicity evaluation and environmental monitoring, I. Simion, Gheorghe Asachi Technical University of Iasi Romania; B. Morin, J. Cachot, University of Bordeaux / EPOC; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; L. Blaha, Masaryk University, Faculty of Science / Research Centre for pesticide treatment in the environment RECETOX

Pesticides are widely used throughout the world in many agricultural and domestic activities. By their presence in the environment, they can have an impact on non-target organisms. Moreover, due to the persistence of some products and the formation of active metabolites, more or less complex mixtures of pesticides can be found in the environment. Thus, the aim of this study was to evaluate the effects of one herbicide (S-metolachlor and his two metabolites) and an insecticide (imidaclopride) on the embryo-larval development of two non-target aquatic organisms. These pesticides are the most abundant representatives of their groups in the shallow coastal Bay in France. We were focused on the non-target relevant concentration in this Bay (1 μg/L for herbicides and 0.2 μg/L for insecticide and 2-3 higher concentrations) and their sub-lethal effects on the oyster (C. gigas), which is widely present in the Bay due to oyster farms and the zebrafish (D. rerio), chosen as a prototypical (eco)toxicology model organism. Firstly, the embryos were exposed to the separate substances, then the mixtures for 5 days (zebrafish) or 2 days (oysters). The malformations, the locomotion activity and target gene expression levels were assessed to understand the mechanisms of possible sublethal toxicity of the selected pesticides. According to our results, no malformations and no effect on locomotion activity for the tested concentrations were observed for zebrafish. On the contrary, the effects on the malformations and the locomotion activity of the oyster larvae is already induced at low concentrations of the selected pesticides. The first results of the gene expression show an overexpression of some of the selected genes of zebrafish (12S, TR-beta – known to be related to the thyroid disruption) caused by one of the metabolites of herbicides. In conclusion, an indication of a novel mode of action of the chronic pesticide toxicity has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH275 Including multistress in risk assessment of pesticides. Current state of knowledge, based on a literature review and evaluation of tank mixture applications in a spraying schedule for strawberries.
P. Van de Zande, University & Research / Agrosystems Research; L. Wipfler, Alterra Wageningen UR; H. Holterman, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; W. Beltman, Alterra Wageningen UR; H. Holterman, Wageningen University & Research / Agro systems Research; L. Wipfler, Alterra Wageningen UR / Environmental Risk Assessment Team; J. Van de Zande, Wageningen University and Research / Agrosystems Research

This study presents a number of stepping stones towards answering the question if the current product-by-product and active substance-by-active substance evaluation provides sufficient protection in the context of the authorisation of plant protection products (PPPs) in the Netherlands. This report is based on a literature review and an evaluation of tank mixture applications in a spraying schedule for strawberries. The topic of tank mixes has been identified by Ctgb (the Board for the Authorisation of Plant Protection Products and Biocides in The Netherlands) as an indication of a novel mode of action of the chron substances residues. Therefore, the risk assessment of PPPs needs to be considered that PPPs are part of a crop protection programme and thus should be evaluated in this context. Keywords: multistress, pesticides, environmental risk, aquatic Poster presentation

TH276 MODELLING ACUTE AND CHRONIC RISKS OF PESTICIDES RESIDUES IN SOUR CHERRIES
I. Simion, Gheorghe Asachi Technical University of Iasi Romania; R. Hilhor, Gheorghe Asachi Technical University of Iasi, Romania / Environmental Engineering and Management; P. Manuela Olga, PhytoSanitary Office / Department of Environmental Engineering and Management; M. Rosca, Gheorghe Asachi Technical University of Iasi Romania; P. Cozma, Gheorghe Asachi Technical University of Iasi Romania / Environmental Engineering and Management; M. Gavrilescu, Gheorghe Asachi Technical University of Iasi Romania / Department of Environmental Engineering and Management

To destroy or prevent insects, rodents, and weeds that might harm agricultural crops, and to control and mitigate plant diseases, farmers started to use pesticides, which are highly toxic chemicals or mixtures. Due to their persistence in the environment and ability to bioaccumulate in living organisms, pesticides generate environmental and human health impacts and risks, which are in a complex relationship. The present study proposes a model strategy to regulate and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMo model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in doubling and in increasing doses ensuring that all plantation areas are subjected to the experiments. We followed variation of environmental conditions: temperature, humidity, rainfall patterns and pesticide dissipation in time considering each treatment. The results of pesticides concentration at harvest allowed us to model the pesticides risks to human health. Based on our assessment, it appears that acute and chronic risks of pesticides residues in sour cherries are low. Sour cherries dietary intake of pesticides residues poses an acute risk for children lower than 64.6% and lower than 22.5% for adults. The highest chronic risk level reaches 2.4% for adults and 9.5% for children. Our study suggests that the risk assessment estimates are strongly influenced by age and dietary preferences.

TH277 Environmental and Human Cumulative Risk Assessment of Pesticides Using Local Monitoring Data: A Case Study from the Pucara River Basin, Bolivia
L. Herrera Noarego, University of Copenhagen / Department of Plant and Environmental Sciences; M. Álvarez Caero, H. Antezana Fernández, Universidad Mayor de San Simon / Facultad de Ciencias y Tecnología; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

Pesticides are widely used throughout the world in many agricultural and domestic sectors (e.g., petrochemical, personal care) have developed frameworks and processes to manufacture environments or plant-derived materials. Several industrial sectors (e.g., petrochemical, personal care) have developed frameworks and methodologies to characterize and analyze these complex substances, and best practices and key research needs were identified at the workshop to support
environmental risk assessment. Bridging from the workshop discussions and conclusions, a new HESI Emerging Issues Committee was formed in late 2017, with the overall mission to develop a tiered approach to UVCB and MCS ecological risk assessment. Initial objectives of this committee are to identify and develop models and methods, develop best practices and guidance, and engage with multi-stakeholder collaborative research projects. This presentation will highlight the initial goals and strategy of this multi-stakeholder, collaborative group.

TH279

Environmental Risk Assessment of Technical Mixtures under REACH

E. Hassold, W. Galert, German Environment Agency - UBA / IV 2.3 Chemicals; W. Dess, Federal Environment Agency (UBA) / Chemicals

During their processing and downstream-use substances are blended together in formulations, are reformulated for different uses and end up in a variety of products. REACH addresses the safe use of single substances in technical mixtures, but not explicitly the risks arising from joint effects and exposures of the components. In contrast to other substance-oriented regulations, not the authorities, but the registrants and downstream users have to assess and guarantee the safe use of the registered substances, formulations and products. Recently, some attempts have been made by industry organizations with the concept of LCID/SUMI to improve the assessment and communication of safe use conditions for technical mixtures. However, essential improvements are needed. The development of sound prioritization criteria is essential for a mixture assessment. But a sole consideration of the component-based approach and the use of data on single substances is unsatisfactory.

TH280

Natural complex mixtures: Ecotoxic behaviour, what we know and what is next?


With June 2018 coming, the registration steps of chemicals under REACH review program come to an end but with much more to follow. But now it is time to consider the overall tasks we performed to meet that 2018 deadline. All the different classes of organic substance under REACH were considered during the Phase-in period: monocomponents, multicomponents, & UVCBs. Amongst these substance types, general framework to perform present and need to be built up. Indeed, detailed guidance and assistance is needed for formulators of mixtures to enable the assessment of a safe use of mixtures. An implementation in guidance documents needs to involve all stakeholders (authorities, industry, academia) and approaches should be followed and evaluated with respect to their feasibility and a sound risk assessment in case studies.

TH281

Testing chemical mixtures: how to determine the effects concentration(s)?

G. Deviller, DERAC / TERA PRAPS HSE

When the properties of a mixture cannot be estimated from the related properties of its components then testing on the mixture is required under most chemical regulations. However, the available standard methodologies to assess the environmental fate and toxicity have been developed for single substances and are often not directly applicable to mixtures. The first issue is related to the identification of the relevant constituents to monitor during the tests (e.g. composition main constituents, bioavailable fraction…) which may differ according to the substance regulatory frame(s). Second, the development of a specific and quantitative analytical method for each relevant constituent could be technically challenging because (1) all analytical standard substances might not be available since some constituents of the mixture are produced by reaction and (2) the different chemical nature of the constituents may require different type of analytical techniques that might not be (all) available in the (same) GLP testing laboratories. Once the analytical data base for a chemical is available, toxicologically relevant concentrations on the measured concentration should be applied for these mixtures? This presentation is intending to discuss these issues and to bring some elements of response based on case studies.

TH282

Deriving USEtox human non-cancer toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program

F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, M. Fuart-Gatnik, M. Pavan, S-IN Solutioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

The Product Ecotoxicity Screening (PEF) is a core part of the European Commission (EC) Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). Based on these methods, the potential impact on humans and ecosystems of chemicals emitted during the life cycle of a product is assessed via USEtox model. To this aim, USEtox requires the modelling of constituent hazards for a chemical. Focusing on human health (HH), the EC Joint Research Centre has recently obtained from the European Chemicals Agency (ECHA) genotoxicity and repeated dose toxicity (RDT) data (41'381 test results, as of March 2017) generated under the REACH Regulation. Based on these data, data-selection criteria were defined to automatically derive non-cancer HH toxicity effect factors (using R-studio) for thousands of chemicals in USEtox. Genotoxicity data were not retained in the assessment, being associated with qualitative outcomes, and rules for cancer HH effect factors were not derived, since the USEtox ED50, and cancer-TDI50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the REACH data, included in the RDT endpoint study records (ESRs) via the oral and inhalation route, were used to define selection criteria for non-cancer HH effects, in particular: reliability, adequacy, type of information, test guideline, GLP, species, duration of exposure, route of administration, effect level qualifier, effect level, unit, effect level based on, basis for effect levels. A tiered approach for selecting good quality data was also proposed, based on four quality levels, where studies of the highest quality (key studies, Klimisch 1/2) were included in the first two levels.

TH283

Deriving USEtox aquatic freshwater toxicity Effect factors from OpenFoodTox database (EFSAs) using R-Studio program

E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, S-IN Solutioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risks Assessment; J. Richardson, EFSAs / AMU; D. Worteg, Eurofarma LLC / Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). There are currently 25 PEF and 2 OEF pilots testing the method and developing Product Category Rules (PCR) in order to improve potential input data for a chemical. An important step is to assess the USEtox multimedia fate model [3]. This model requires ecotoxicity data to freshwater aquatic life. For PEF/LCA, those data are required for thousands of chemicals using the most up-to-date information [4,5]. The USEtox OpenFoodTox database was used to extract the information required to calculate effect factor for Plant Protection Products. EFSAs has populated a chemical hazards database to hold summary hazard data from EFSAs’s chemical risk assessments in food and feed (Barbaro et al. 2015; Dorne et al. 2017). The data are freely accessible via the EFSAs website OpenFoodTox but also accessible via downloadable Excel files. From the OpenFoodTox database, 2695 ecotoxicological observations were...
available for about 451 chemicals. After selecting the appropriate data, species geometric means have been calculated for each toxic group. The following final calculation have been performed for thousands of chemicals: - Acute and Chronic species geometric means with standard deviation and number of individual test available per species - Arithmetic average of all the log of the species geometric mean with standard deviation and count of species as well as count of SSD group for each chemical and Chronic species geometric means with standard deviation. Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TH284 Bioassays for assessing effects of overall mixture from food contact materials K. van Wezel, E. Reygrobellet, J. Muncke, Food Packaging Forum Foundation / General Management

Food contact articles (FCAs) are made from highly diverse materials, and they are chemically complex. FCAs can transfer their chemical constituents, the so-called food contact chemicals (FCCs), into foods. Exposure to FCCs is assumed to be highly relevant in the context of human exposure to (synthetic) chemicals. To assess the risk to human health from chronic ingestion of FCCs, basic information on migrating chemicals must be available, such as their chemical identity. However, this is often not the case for all migrating FCCs, especially the non-intentionally added substances (NIAS), as some or most NIAS typically remain unknown, depending on the type of FCA. Furthermore, the current approach to chemical risk assessment is focused on single substances, while it is known that migrating FCCs migrate simultaneously, forming the ‘overall migrant’ and resulting in typical and predictable mixture exposure scenarios. One alternative approach to estimating chemical hazards of FCAs is to assess biological effects of the overall migrant. In addition to assessing mixture toxicity this approach also includes effect-assessment for unknown NIAS which otherwise remain unassessed. We review this approach, discuss benefits and disadvantages, and highlight future research needs.


Inspired by methods and tools developed in the field of life cycle analysis (LCA), we developed an index of indirect toxicity to the human health and the environment to be compared. The index is based on the concept of the Potential Effectively Affected Fraction (PEAF), used here as a damage indicator at the ecosystem level. This concept expressed initially the toxic pressure on the environment due to one chemical. It has been enlarged to mixtures of substances as multi-substances PAF (ms-PAF), and yet applied to a mix of stable and radioactive substances. Combining ecotoxicity data and a simplified model of exposure of fauna and flora, we proposed a chemotoxicity index and a radiotoxicity index, which definitions ultimately allow the estimation of a single index. According to acknowledged practices in LCA and corresponding available data, we suggested declining this approach to human health, taking into account exposures resulting from both ingestion and inhalation pathways. This led to eight basic indexes, which may be aggregated on substances, effects categories or exposure pathways to produce intermediate indexes. The principle of additivity that underlies the whole proposed approach may authorize their complete aggregation in order to produce a unique index also for human health. Different source terms may be then easily directed compared in terms of human and ecological noxiosness.

TH286 Solution-focused application of mixture modelling and chemical footprints M.C. Zijp, RIVM / Centre for Sustainability Environment and Health; J. van Gils, DELTARES; A. van Wezel, KWR Watercyle Research Institute / Chemical Water Quality and Health; D. De Zwart, Diz Ecolot / Centre for Sustainability Environment and Health; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health

Status reports of the Water Framework Directive suggest many cases of non-compliance according to formal criteria for Good Ecological and Good Chemical Status as well as for River-Basin Specific Pollutants. This signals problems for both the assemblages of species and the functions we try to protect. Multiple stressors, including 100k chemicals and their mixtures, are the causal agents. In the FP7 project Solutions, a modelling train is developed with the purpose to support derivation of water quality management plans that provide best value for money regarding chemicals and their mixtures, i.e., help to identify the largest potential risk reduction per euro spent. Thereby, the challenge is to focus on those chemicals that matter most, which can result in prioritization to sites (where are largest impacts to be expected), to times (when are largest impacts to be expected, e.g., crop-growing season & pesticides), to affected species groups (which species (groups) are most sensitive to the present impact) and to compounds (which chemical (groups) contribute most to local impacts). Collaboration with the FP7-project MARS (on multiple-stress effects on ecological status) forms a multi-stress, multi-chemical approach. In SOLUTIONS, the modeling train will result in complex chemical footprints (ChF). ChFs were developed to summarize and communicate predicted mixture risks in simple units. In the current presentation, ChFs are evaluated in terms of the net contributions to predicted mixture impact of emissions in one region, e.g., a sub-catchment, on the mixture toxic pressure in the total river downstream, including the estuary. Hence, it explained both potential transport of a mixture from one region to other and the information that can be obtained by single-chemical risks, chemical footprints indicate which combination of chemicals and locations require priority for abatement. We present ChF-analysis results for the river Rhine. The river basin was divided in more than 800 sub-basins and chemical footprint information resulting from the emissions of a large amount of chemicals are derived from hydrology driven spatially and temporally explicit modelling for the whole catchment. Subsequently, abatement priorities are proposed, based on the ChF results, that act on the most severe combinations of chemical and region of emissions. The effects of local risk management are expressed in reduced toxic pressure in all downstream sections of the river.

TH287 One-week observation of phthalate metabolites in urine from 12 Korean adults: Exposure levels, profiles, and source identification J. Lim, Hanyang University; S. Kim, Seoul National University Graduate School of Public Health; I. Lee, Seoul National University / Department of Environmental Health Sciences; A. Lee, Soonchunhyang University; S. Kim, Y. Kho, Eulji University; J. Park, SOO-CHUN HYANG UNIVERSITY; K. Cho, Seoul National University / Environmental Health Sciences; H. Moon, Hanyang University / Marine Sciences and Convergent Technology

The excreta of phthalic acid (phthalates) are representative endocrine disrupting chemicals (EDCs) to cause a variety of adverse health effects to humans. Phthalates have been primarily used as additives of the plastic products, cosmetics and personal care products (e.g., DEP). Phthalates are metabolized and eliminated in urine within few hours after human exposure. Due to a short half-life of phthalates, the urinary phthalate metabolites are utilized as an indicative for integrative exposure to phthalates from multiple sources and pathways. In this study, all of the urine samples for 7 days (n=401) were collected from 12 adults to identify the dominant exposure levels, profile and exposure pathways of phthalates for different population groups. Eighteen phthalate metabolites include mono-ethyl phthalate(MEP), mono-ethyl phthalate (MEP), mono(2-ethyl-5-oxohexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-carboxyethylhexyl) phthalate (MCPH), and mono(2-ethyl-5-carboxypentyl) phthalate (MPCP) were analyzed. Among 18 phthalate metabolites, MEHP, MEHP, MEHP, MCPM, MECP, MBP, MEP, and MBP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MiPP, MiNP, MOP, and MPeP were rarely detected in all of the urine samples (<10%). Total concentrations of phthalate metabolites ranged from 3.12 to 630 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites (mono(2-ethylhexyl) phthalate (MEHP), mono(2-ethyl-5-oxo-hexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-carboxyethylhexyl) phthalate (MCPH), and mono(2-ethyl-5-carboxypentyl) phthalate (MCP) were among the most abundant. The results of this study will call for the urgent attention of further researches which can bridge the knowledge gap of the urinary phthalate metabolites in urine from the Korean population. The bioavailability and health effects of the urinary phthalate metabolites are utilized as an indicative for integrative exposure to phthalates from multiple sources and pathways. In this study, all of the urine samples for 7 days (n=401) were collected from 12 adults to identify the dominant exposure levels, profile and exposure pathways of phthalates for different population groups. Eighteen phthalate metabolites include mono-ethyl phthalate(MEP), mono-ethyl phthalate (MEP), mono(2-ethyl-5-oxohexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-carboxyethylhexyl) phthalate (MCPH), and mono(2-ethyl-5-carboxypentyl) phthalate (MPCP) were analyzed. Among 18 phthalate metabolites, MEHP, MEHP, MEHP, MCPM, MECP, MBP, MEP, and MBP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MiPP, MiNP, MOP, and MPeP were rarely detected in all of the urine samples (<10%). Total concentrations of phthalate metabolites ranged from 3.12 to 630 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites (mono(2-ethylhexyl) phthalate (MEHP), mono(2-ethyl-5-oxo-hexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-carboxyethylhexyl) phthalate (MCPH), and mono(2-ethyl-5-carboxypentyl) phthalate (MCP) were among the most abundant. The results of this study will call for the urgent attention of further researches which can bridge the knowledge gap of the urinary phthalate metabolites in urine from the Korean population.

TH288 Integrating chemical monitoring data with high-content effects data to prioritize contaminants and hazards in chemical mixtures D. Martinez-Weirich, University of St. Thomas / Biology; A. C. Meihnto, Southern California Coastal Water Research Project / Toxicology; N. Vinas, US Army Engineer Research and Development Center; A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; E.M. Curran, University of St. Thomas; C. Lai, University of St. Thomas / School of Engineering; Y. He, University of St. Thomas / School of Engineering; M.L. Ferrey, Minnesota Pollution Control Agency / Environmental Outcomes

Determining ecological risks associated with exposures to complex chemical mixtures in the environment is challenging. Bioeffect-based monitoring tools that can measure integrated biological activity of mixtures have been proposed as one of
the solutions. A limitation of these is that they typically do not provide insight into which chemicals are causing the observed biological responses. Utility of methodologies that integrate chemical monitoring with bio-effects data to prioritize chemicals and hazards in complex mixtures will be discussed. More specifically, outcomes of a Minnesota streams case study are used to critically evaluate approaches where: 1) prior knowledge regarding toxicity of detected chemicals is combined with empirical, in situ bio-effects assessments, and 2) where in situ chemical and bio-effects data are integrated directly (without the prior knowledge of toxicity of individual chemicals). Samples from 50 randomly selected locations in Minnesota were analyzed for 146 chemicals of emerging concern. Concurrently, at 10 sites, exposures of fathead minnows to stream water were conducted (48h, custom 60K feature microarray platform, liver, Norlite, University of Michigan); toxicity and public bio-effects data for individual chemicals were integrated to prioritize chemicals and predict biological targets of detected chemicals for each site. Partial least-squares (PLS) regression and association rule learning (AR) were used to identify associations between in situ chemistry and in situ transcriptomic effects. At most sites, both prior knowledge-based predictions and fish transcriptomics, indicated activation of estrogen receptor alpha and peroxisome proliferator-activated receptors; their predicted chemical initiators were bisphenol A, caffeine, carbamazepine, and triclosan. Some chemicals (triclosan) were indicated by both knowledge-supervised and direct data integration approaches, but iopamidol (detected at 78% of MN sites) and metformin were only indicated by PLS and AR. Estrogenic effects remain of special concern as all methodologies indicated disruption or estrogen receptor signaling. Collectively, and in general, toxics are a major environmental concern. These three health danger zones – chemical inventories of WWTP effluents were analysed to gather information on the solutions. A limitation of these is that they typically do not provide insight into which chemicals are causing the observed biological responses. Utility of methodologies that integrate chemical monitoring with bio-effects data to prioritize chemicals and hazards in complex mixtures will be discussed. More specifically, outcomes of a Minnesota streams case study are used to critically evaluate approaches where: 1) prior knowledge regarding toxicity of detected chemicals is combined with empirical, in situ bio-effects assessments, and 2) where in situ chemical and bio-effects data are integrated directly (without the prior knowledge of toxicity of individual chemicals). Samples from 50 randomly selected locations in Minnesota were analyzed for 146 chemicals of emerging concern. Concurrently, at 10 sites, exposures of fathead minnows to stream water were conducted (48h, custom 60K feature microarray platform, liver, Norlite, University of Michigan); toxicity and public bio-effects data for individual chemicals were integrated to prioritize chemicals and predict biological targets of detected chemicals for each site. Partial least-squares (PLS) regression and association rule learning (AR) were used to identify associations between in situ chemistry and in situ transcriptomic effects. At most sites, both prior knowledge-based predictions and fish transcriptomics, indicated activation of estrogen receptor alpha and peroxisome proliferator-activated receptors; their predicted chemical initiators were bisphenol A, caffeine, carbamazepine, and triclosan. Some chemicals (triclosan) were indicated by both knowledge-supervised and direct data integration approaches, but iopamidol (detected at 78% of MN sites) and metformin were only indicated by PLS and AR. Estrogenic effects remain of special concern as all methodologies indicated disruption or estrogen receptor signaling. Collectively, and in general, toxics are a major environmental concern. These three health danger zones – chemical inventories of WWTP effluents were analysed to gather information on
explained by few compounds which varied between sampling sites and dates (e.g. seasonal use of pesticides). Overall, WTPs increased mixture toxicity in the receiving surface waters. For most samples highest SUM TU could be calculated for macrophytes and algae. As a substance highly toxic for algae Triclosan generated high TU. It was detected in nearly all WWTP effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be a possible risk for the aquatic organisms. In waterbodies strongly influenced by WWTP discharges Dichlofenac and Ibuprofen were nearly ubiquitous and caused high chronic toxic stress to fish. It was concluded that a combination of single substance risk assessment and mixture toxicity assessment is a suitable tool to evaluate complex monitoring data. Monitoring of substances with high TU (contributing mainly to mixture toxicity) could help to identify surface water for a more extensive monitoring and support specific management planning.

TH293 Assessing groundwater toxicity of emerging contaminant mixtures M.D. Pavlaki, University of Aveiro / Department of Biology; F.J. Mousinho, University of Aveiro / Department of Biology and CESAM; A.R. Silva, University of Aveiro / Department of Chemistry & CESAM; S. Gonalves, Dotigrona and Cremona; T. Backhaus, University of Gothenburg / Department of Biological and CESAM - University of Aveiro / Department of Biology and CESAM; R. Morgado, University of Aveiro / Department of Biology and CESAM; S. Loureiro, Universidade de Aveiro / Biology

Groundwater is one of the most important natural resources, as globally it comprises the primary available source of freshwater. Groundwater aquifers consist of an important drinking source in many parts of the world and a point of supply for irrigation in agriculture, among others. Additionally, groundwater aquifers are considered valuable in sustaining ecosystems’ health and functioning. The Groundwater Directive (2006/118/EC) was created to protect groundwater bodies from contamination but to date it does not consider a diverse array of emerging contaminants in great quantities by society. These emerging contaminants can often occur in mixtures rather than alone, therefore understanding and predicting the toxicity of such complex mixtures, will eventually lead the way to developing new strategies for setting adaptations in regulations. Additionally, adapting surface water protocols to groundwater contamination scenarios might lead to erroneous results due to water different composition. The present work was performed in the context of the European Research Project WE-NEED (Water JPI-WATERWORKS2014 ERA-NET) focused on developing new management strategies to sustainably exploit groundwater resources. A thorough identification of emerging contaminants took place in two well-characterized case-studies, the Bologna and Cremona aquifers. For that, four priority contaminants identified in the two aquifers were chosen as model chemicals and synthetic water was built to mimic the groundwater composition from the identified aquifer. The acute toxicity of complex mixtures in these synthetic groundwaters was tested in Daphnia magna and deviations from the Concentration Addition reference model were assessed. Based on this step, the toxicity of three emerging compounds and their mixtures (binary and ternary) were assessed in the two synthetic groundwaters using adapted standardized protocols for Daphnia magna (OECD 202) and Danio rerio (OECD 203). To utilise models for mixture toxicity, binary mixtures was used to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicated interaction between the contaminants in D. magna and D. rerio.

TH294 Mixtures effect of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast C. Jonander, University of Gothenburg; I. Dahlöf, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

In coastal ecosystems components like nutrients and contaminants are not present on their own but in mixtures. A chemical monitoring survey detected more than 60 organic chemicals along the west coast of Sweden in 2012, many of which exceeded their environmental thresholds. A total of 33 chemicals was found to co-occur in the water column of the coast of Stenungsund, an area with multiple harbours and home to Sweden’s biggest chemical industry cluster. Dibutyl phthalate (DBP) and Sodium dodecyl sulphate were among the highest risk substance and structural changes (concentration / ecotoxicity). We therefore investigated their single substance and mixture toxicity to natural mesozooplankton communities, which constitute an important link between primary producers and higher trophic levels like fish. Structurally diverse communities generally possess a large resilience capacity, and it is thus essential to identify sensitive species and structural changes caused by chemical exposure. Potentially, structural changes on this level could indirectly affect even higher levels of biological complexity. We used copepod egg production, hatching success and feeding rate as our primary ecotoxicity parameters, complemented with dead/alive staining of zooplankton with neutral red dye after the exposure. Additionally, we analysed the community structure before and after chemical exposure by image analysis, comparing images of the exposed samples and untreated controls to a manually classified reference library of mesozooplankton taxa. Single substance experiments show toxic effects on the zooplankton communities by decreasing copepod egg production and hatching success in a concentration-dependent manner, with first effects becoming visible at concentrations of 0.20 μM DBP (50%) and 0.32 μM DBP (50%), respectively. The interaction of structural endpoints as well as the mixture experiments are currently (Nov/2017) ongoing and will be presented on the poster.

TH295 Analysis of the mixture toxicity burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef E. Spilsbury, University of Gothenburg / Dept of Biological and Environmental Sciences; M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 2300km along the coastline in north-eastern Australia. A total of thirty-five major river basins discharge to the GBR and many transport large loads of pesticides, suspended sediments, nutrients from agricultural land. Over the past 6 years an extensive program has been conducted by the Queensland Government to monitor concentrations of 51 pesticides and their breakdown products in 17 rivers that discharge to the GBR. To explore the potential impacts of these pesticides and their mixtures on the riverine environments and to the GBR we analysed the risk posed by the individual pesticides and their mixtures. Australia currently does not have water quality guidelines for 17 of the 38 pesticides detected. For those, we calculated ecotoxicity thresholds using a simplified version of the Australian methodology for determining water quality guideline values, based on species-sensitivity distributions. In all rivers, multiple pesticides were routinely present in concentration above or equal to their level of reporting. All rivers had at least one sample where the combined toxicity was greater than 1 toxic unit (TU), i.e. exposure situations where the total pesticide concentration exceeded acceptable levels. In a number of rivers more than 50% of samples had a combined toxicity greater than 1 TU. Average TU’s per river ranged from 13.47 to 0.10, with substantial fluctuations over the seasons but without clear trends between years. The patterns indicate that specific events such as severity of wet/dry seasons and cyclone events impact the combined toxicity found. We also found land use patterns affected the combined toxicity in the river ecosystems. In each of the rivers, 90% of the expected mixture toxicity was caused by only between 2 and 6 pesticides, although the individual pesticides that dominated the combined toxicity differed between rivers.
The worldwide demand for fuels is increasing, but currently used fuels are based on fossil resources. A possible alternative for diesel is the biofuel mixture of 1-octanol and butyl ether (DnBE) (20%). These fuels are based on the raw material lignocellulose and its degradation products. However, the mixture indicates a critical role in environmental contamination, especially for aquatic ecosystems. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction of the two substances. Acute embryotoxic and developmental effects were investigated in the fish embryo toxicity test (FET) with Danio rerio (OECD 236). The acute immobilization assay (OECD 202) was performed to determine the EC₅₀ value of this mixture in both single exposure and mixture exposure to screen AhR antagonistic activities. We show that these compounds have species specific activities. The IC₅₀ for the POP mixture was 262.6 ± 104.6 mg/L for 1-octanol and 17.3 mg/L for DnBE. Both biofuels led to teratogenic and lethal effects in the FET (LC₅₀: DnBE: 24.7 mg/L; LC₅₀, 96 h: 11.3 mg/L). Especially in the study of DnBe was a low hatching rate, while embryos were often observed at the pericardium of the developing larvae. Testing the mixture in the FET revealed a LC₅₀ of 14.7 mg/L. The acute immobilization test resulted in a EC₅₀ of 25.6 mg/L. The determined EC₅₀/LC₅₀ values in both bioassays suggest an additive mode of action of the compounds. The comparison of the determined values with data of other biofuels (2-methylfuran, 2-methyltetrahydrofuran) showed a higher toxicity of the mixture.
inherent to the use of the insecticide abamectin and the fungicide difenoconazole, the main objective of this research was to evaluate the effect generated in Danio rerio embryos exposed to pesticide mixtures and evaluate the effects produced by the interaction of these compounds. For this, Danio rerio embryos were exposed for 96h to the binary mixtures of abamectin and difenoconazole following the recommendations of OECD TG 236. The concentrations used were 0.5; 1; 1.24; 5.3 and 1.7 mg L\(^{-1}\) of abamectin and 0.2; 0.5; 1; 2.3 and 5.0 mg L\(^{-1}\) of difenoconazole. The factorial design was used combining all possible concentrations, and in total 35 treatments plus the control were performed. The exposures were performed in 50 mm Petri dishes using three plates per treatment. In each plate containing 15 mL of solution were arranged 5 eggs totaling an n = 15. Survival data were recorded every 24 hours and the results were analyzed in the Mixtox program. The LC50 values for abamectin and difenoconazole promote in Danio rerio embryos the antagonistic effect in the lower concentrations, but in higher concentrations the produced effect is synergic. This means that, at lower concentrations the interaction of abamectin + difenoconazole seems to decrease the toxicity of pesticides to Danio rerio embryos, but the toxicity of the compounds is potentiated at higher concentrations of the mixture. Indeed, the mixtures' toxicity is higher on exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

**TH302**
Cocktail-effect of persistent organic pollutants on selected bioreactor-systems and zebrafish embryos
N. Pagano, RWTH Aachen University; G. Nilen, B. Holmes, M. Larsson, M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); H. Hollert, RWTH Aachen University / Institute for Environmental Research; S. Keiter, Orebro University / MTM Research centre
There is an ever-increasing number of chemicals including pharmaceuticals and industrial pollutants that are released into the aquatic environment, leading to the exposure of fish and other aquatic organisms. Moreover, at the present time environmental risk assessment is mainly based on chemical analysis, only. However, “compound-by-compound” based assessments seriously run the risk ofunderestimating the risk of chemicals as the true exposure scenario for humans and wildlife is known to be far more complex. Under regular environmental conditions organisms can be exposed to multiple chemicals associated with different risks and specific effects, e.g. teratogenicity, immune toxicity and suppression, genotoxicity, and endocrine disruption. Moreover, it has been repeatedly demonstrated that pollutants and the underlying toxic responses may interact and generate effects that are different from the toxicity of the individual chemicals. Thus, understanding the effects of similar mixtures generally referred to as “cocktail effects” represent one of today’s greatest challenges in environmental but also in human toxicology. The aim of the present study is to investigate embroyotoxic and teratogenic, but also mechanism-specific effects using zebrafish embryos. They will be exposed to selected priority pollutants and their mixtures (e.g. polychlorinated biphenyls, heavy metals, polycyclic aromatic compound). These chemicals represent highly relevant chemicals which can be found in great levels in the environment. First results indicate that beside biological interactions heavy metals may alter the toxicity of organic pollutants. This study is part of the EnForce project (https://www.ora.se/enforce), which aims at the development of an effect-based risk assessment in cooperation with different stakeholders and several industrial partners.

**Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking (P)**

**TH304**
Environmental impact assessment of carbon fibers reinforced composites: pyrolysis process
The end-of-life management of carbon fibers reinforced composites (CFRCs) has been investigated by comparing the environmental sustainability of Curti S.p.A. company’s pyrolysis process with waste-to-energy (WtE) and landfill disposal. The determination of environmental loads was carried out through the Life Cycle Assessment (LCA) methodology, modeling and analyzing each scenario through different tools: TOOLware and Ecoinvent database. CFRCs are highly engineered materials, with high caloric power and excellent mechanical properties. From their recovery, it is possible to obtain a secondary raw material that can be used in application requiring lower performance than originals, or the recovery of thermal/electrical energy. The market still offers few CFRC recovery technologies. Therefore the most developed ones have been chosen to compare with landfill disposal, even though nowadays it would be avoided, for waste with a LHV+ 13 MJ/kg [1]. The pyrolysis process involves a first pyrolysis and a subsequent gasification of the waste within the same reactor. This system allows the quantitative recovery of carbon fibers (CF) contained in the initial composite and generates hot gaseous compounds that are burnt and released into the atmosphere. Since the plant is at a pilot scale, a heat recovery system has not been designed yet for the combustion of fumes. Considering the impact assessment results, pyrolysis has proved to be the most sustainable treatment due to the quantitative recovery of carbon fibers, which avoids the consumption of material and energy deriving from the production of virgin carbon fibers. The worst scenario is WtE, mostly due to the emissions generated in air and water. The impact of landfill disposal is intermediate, due to the good stability of CFRCs: having a slow degradation, their disposal in landfills does not cause an high impact, except for land occupation. The LCA study made it possible to carry out a preliminary assessment supporting the pyrolysis pilot plant design, to identify critical aspects and strengths of each scenarios. [1] Legislative Decree n°36 of 13 January 2003; Implementation of Directive 1999/31/EC on landfill of waste, Official Journal of the Italian Republic, 2003. [2] Legislative Decree n°205 of 3 December 2010; provisions implementing Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste, Official Journal, 2010.

**TH305**
Critical raw materials in a new building integrated photovoltaic system
D. Garrau, I. Herrera, Y. Lechón, CIEMAT / Energy Dpt Energy Systems Analysis Unit
REELCOOP, an EU-FFP funded project which stands for RENewable ELEcTricity COmmunity (www.reelcoop.com), aims to develop and test novel prototypes of electricity generation technologies. One of the prototypes is a solar photovoltaic (PV) ventilated façade (6 kW) and involves the development of c-Si solar cells, as well as the study of the ventilation effect in PV façades. PV solar panels have particular metals or rare earths that are potentially included in the category of “critical raw materials (CRMs)”. This work aims to identify the potential CRMs in this photovoltaic prototype and to define several ways to improve the sustainability from a life-cycle approach, including aspects like substitution or recycling of these materials.

**TH306**
Environmental sustainability assessment of a biological Active Pharmaceutical Ingredient: A resource based Life Cycle Assessment
A.G. Rentería Galán, Ghent University / Department of Sustainable Organic Chemistry and Technology; W. De Soete, Ghent University / EnVOC; B. Heirman, Johnson and Johnson / EHSS Product Stewardship; J. De Graaf, Janssen Biologics / Safety Health Environment; S. De Meester, Ghent University / Department of Industrial Biological Sciences; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology
Most Life Cycle Assessments (LCAs) performed in the pharmaceutical sector have been done on chemically synthesized drugs, leaving biopharmaceuticals aside. The fact that sustainability assessments of biopharmaceutical products and technologies have been rarely done is probably a consequence of the major challenge that building a robust Life Cycle Inventory (LCI) represents for the upstream and downstream processes of biologics. However, the low number of LCAs performed on biopharmaceuticals does not reflect the current reality of the pharmaceutical sector, as its market is rapidly growing at an annual rate of around 9%. Therefore, this study focuses in performing a resource based LCA to measure the environmental impact of a biological Active Pharmaceutical Ingredient (API). A resource based methodology is used to take into the account the addressing the task that adversaries face in supply and efficient use of resources. The API investigated is infliximab, a monoclonal antibody that treats autoimmune diseases. An Exergetic Life Cycle Assessment (ELCA) was conducted, using the Cumulative Exergy Extracted from the Natural Environment (CEENE) method. First results show that the unit operations with the highest impact are: i) The first chromatographic process for purification (Direct Product Capture), since it requires the highest quantity of buffers which are produced using chemicals as well as complex organic compounds such as amino acids. ii) Fermentation, as similar complex components are required for its medium, which are also produced through biotechnological processes. Furthermore, fermentation is the process that takes the longest (several days), leveraging the Heating Ventilation and Air Conditioning (HVAC) system to achieve the clean room conditions needed for the production of biologics. HVAC has shown to be the utility with the highest impact, consuming a significant percentage of the total electricity used in the plant. Performing an LCA on a biologic mainly using primary data has been proven to be a possible task. However, challenges such as the data unavailability of biotechnologies used to produce the nutrients needed throughout the process, as well as the further integration of these technologies into databases should be addressed.

**TH307**
LCA methodology: a case study of the industrial production of terephthalic acid from renewable sources
S. Perilli, Università di Bologna / Industrial Chemistry Tosco Montanari; F. Passarini, Alma Mater Studiorum - University of Bologna / Dept. of Industrial Chemistry; D. Cesi, Environmental management and consulting (EMC) Innovation Lab S.r.l.; E. Neri, Alma Mater Studiorum - University of Bologna; F.
Cavani, Toso Montanari Department of Industrial Chemistry, University of Bologna / Dept. of Industrial Chemistry; P. Mizsey, D. Fozer, Budapest University of Technology and Economics / Department of Chemical and Environmental Process Engineering

The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results achieved by the traditional way with those of three bio-based routes. The aim of the study is to identify which of the selected pathways has the lowest environmental load. Below the four routes selected are briefly described: Traditional way: p-xylene is obtained from catalytic reforming of crude oil as part of extracted BTX (benzene, toluene and xylene isomers); GEVO’s process: isobutanol from the fermentation of biomass is converted into hydrocarbons, iso-octane and p-xylene; Free-flow HMF and ethylene: it involves the production of HMF (5-hydroxymethylfurfural) from starch, its conversion to DMF and the Diels–Alder reaction with bio-ethylene to obtain p-xylene; Alternative pathway from p-cymene: it consists in the oxidation, using O$_2$ in the presence of a catalyst, of p-cymene (derived from orange peels) to obtain TA. The first two routes are already set at industrial level; the others are still under development. Therefore, in order to estimate the energy requirements of the scenario, a simulation of the serial processes was carried out using ChemCad software. The first three syntheses are based on the production of p-xylene, subsequently oxidized to TA through the Amoco process. On the contrary, the last route is proposed as an alternative way, since it uses p-cymene as a precursor of TA. In order to perform the comparison, a LCA (Life Cycle Assessment) methodology has been used as a scientific tool of energy capacity, residence of a technological system, and scale to pilots at SMEs and industry facilities. This project is co-financed by European Union under The Framework Programme for Research and Innovation HORIZON 2020. The project is developed by 10 different partners, where LEITAT is in charge of the Life Cycle Assessment. For that task, the environmental impact has been performed during the whole life cycle considering synthesis, formulation and disposal of printed batteries. The LCA has been focused on comparing the potential impacts of Cu, LFP (LiFePO$_4$) and NMC (Ni-Mn-Co) nanoparticles synthesized, the inks which contain these nanoparticles and the batteries printed with these inks. The LCA applied in the study is based on the standard ISO-framework for LCA (ISO 14040:2006 and ISO 14044:2000). Calculations have been done using the software GABI, and taking as a basis the GABI Database, Ecoinvent Database and the SimaPro assessment method. Functional unit has been defined as “a printed flexible battery to be used for power source” and the scope has been based on the “cradle to grave” approach. Primary data have been prioritised and secondary data from databases and literature have been used when needed. The inventory process has been completed with the information of inputs and outputs gathered from partners. Then, the impacts related to inventory flows have been calculated for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks comparative, and results it can be seen that inks with NMC nanoparticles have higher impacts in most of the impact categories. Specifically, NMC inks represent the highest weight due to raw materials used during NMC synthesis. In addition, the highest impacts in climate change and resource depletion are dominated by Cu inks. After that, the manufacturing of the printed lithium-ion batteries has been analysed. The stack and interdigitated battery has been chosen as demonstrators to compare the batteries printed with these inks. The LCA applied in the study is based on the standard ISO-framework for LCA (ISO 14040:2006 and ISO 14044:2000). Calculations have been done using the software GABI, and taking as a basis the GABI Database, Ecoinvent Database and the SimaPro assessment method. Functional unit has been defined as “a printed flexible battery to be used for power source” and the scope has been based on the “cradle to grave” approach. Primary data have been prioritised and secondary data from databases and literature have been used when needed. The inventory process has been completed with the information of inputs and outputs gathered from partners. Then, the impacts related to inventory flows have been calculated for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks comparative, and results it can be seen that inks with NMC nanoparticles have higher impacts in most of the impact categories. Specifically, NMC inks represent the highest weight due to raw materials used during NMC synthesis. In addition, the highest impacts in climate change and resource depletion are dominated by Cu inks. After that, the manufacturing of the printed lithium-ion batteries has been analysed. The stack and interdigitated battery has been chosen as demonstrators to develop the LCA. Landfill and recycling have been assumed as end of life scenarios. Finally, the conclusions take into consideration the new generation of technologies and their environmental performance.
High-operating-temperature thermal storage materials forTES increasing up to 3
times the thermal capacity. All these solutions are being assessed through a
comprehensive LCA, considering the entire life cycle of materials and components,
from raw material extraction until the end-of-life. A comparative analysis is being
prepared between baseline scenario (with reference materials) and the scenario with
the IN-POWER innovative materials. Along the project different candidate
materials and approaches are being assessed. A developed process looking for high
generation efficiency but environmentally friendly. Some improvements are being made such as: use of aluminium instead of silver in the
mirror reflective coating, to meet the European requirements for use of non-critical
materials; the reduction of materials weight; and the increase in materials
robustness. The expected results are to: Obtain a complete environmental profile
of IN-POWER CSP architecture. Calculate the environmental impacts associated to:
new polymeric materials for mirrors; high absorber coating; high thermal storage
capacity materials; polymeric composite for CSP structure. Evaluate the benefits of
IN-POWER materials compared with reference materials. Evaluate the benefits of
IN-POWER CSP architecture compared with current mature Parabolic Trough Collector technology

TH312
Environmental impact and social influence of an Advanced Adiabatic
Compressed Air Energy Storage (AA-CAES) located in Eisenzer, Austria. The
case of RICAS2020 PROJECT.
A. Clareg, Leitat Technological Center / Sustainability Division; G. Fiscre, Leitat
Tech; Quantitat du Cen / RD Sustabile Sustainability Division; M.R. Rivera, LEITAT / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE
(LEITAT TECHNOLOGICAL CENTER) / Sustainability Division
European society has a highly dependency on electric power. In 2009 European
Union fixed that at least 20% of EU gross final energy consumption have to come
from renewable energy sources until 2020. The increasing use of renewable energy
sources to produce electricity has generated a worldwide challenge: the electric
grid, where the peak production of energy is usually not in phase with the peak
demand; the developing of large scale electric storage systems. The innovative
AA-CAES developed within the RICAS2020 project can solve this problem. In a
CAES the air is compressed in a storage unit when electric energy overproduction is
available, and by the inverse process, is reintroduced in the grid when required in the
high demand periods. Additionally, AA-CAES collects the heat produced by
compression in a specific Thermal Energy Storage (TES) and returns it to the air
when the air is expanded to generate power, delivering higher efficiencies via a
zero CO2 emissions process. RICAS2020 is being assessed under the
Environmental and Social LCA, in order to define improvement measures to
guarantee its sustainable performance. The scope of the LCA covers the
construction and the operation stage of the AA-CAES. Regarding the
construction stage are being assessed: the site excavation methods and the
manufacture of materials needed for the construction of the Cavern and TES.
Respect to the operation stage, the impact of machinery used (turbines, compressors, coolers) are being considered. The main goals of this assessment are to:
quantify the environmental and social impacts and benefits of AA-CAES, compared to current energy storage technologies: Pumped Hydroelectric Energy Storage and Batteries. - Identify which of the candidate materials involved in the
construction of the Cavern and TES have the most suitable environmental
profile. Preliminary results of the environmental LCA of candidate materials
for TES have been obtained so far. 12 scenarios have been generated, by combining 3
construction materials (in the excavation phase: concrete, compact concrete, steel
container, concrete structure) and 4 different storage materials (rocks from the
excavation site, gravel, alumina or silica ceramic spheres). Results have shown that
worst cases are the scenarios that include alumina ceramic spheres as storage
material, due to the high impact of aluminium oxide. The best scenario is the use of
rocks from the excavation site without including structural material.

TH313
Upgrading wastewater treatment technologies in the framework of current
renewable energy policies - an environmental assessment
A. Petit-Boix, University of Freiburg / Chair of Societal Transition and Circular Economy; M. Rufí, Universitat Autònoma de Barcelona / Institute of
Environmental Science and Technology (ICTA); G. Villalba, X. Gabarrull, J.
Rieradevall, Universitat Autònoma de Barcelona / Institute of Environmental
Science and Technology & Department of Chemical, Biological and Environmental
Engineering; E. Molind, Depuración de Aguas del Mediterráneo; M. Suárez-Ojeda, Universitat Autònoma de Barcelona / Department of Chemical, Biological and
Environmental Engineering
A large number of wastewater treatment plants (WWTP) use anaerobic digestion to
treat surplus sewage sludge, which produces methane-rich biogas. This biogas
can be used for cogeneration with the ultimate goal of turning WWTPs into energy
self-sufficient facilities. For this reason, current innovation projects focus on (i)
improving the energy efficiency of the plant and (ii) updating the technologies used in
WWTPs or proposing new processes that increase biogas production. However,
we need to clearly define whether these technological updates and innovations
result in net environmental benefits or generate tradeoffs. Here, renewable energy
policies should align with the environmental goals of energy self-supply in order
to discourage the investment in this type of infrastructure and its potential
environmental benefits. Thus, we question whether upgraded or new wastewater
treatment technologies generate larger environmental impacts when renewable
energy policies are not favorable to the self-supply of energy through cogeneration.
In this case, our study focuses on a conventional WWTP in the city of Rubí
(Barcelona), which currently only removes organic matter. This facility considers
an upgrading project that consists in a new wastewater treatment scheme, i.e., (i) a first
stage of high-rate advanced biological phosphorus removal and (ii) a second stage of autotrophic biological nitrogen removal in two-steps. A life cycle assessment
will determine the environmental impacts and benefits of this upgraded system
with respect to the conventional setup. Policy tradeoffs will also be assessed. This wastewater treatment plant originally benefited from cogeneration, but eventually decided to use biogas flare systems due to the taxes on self-supply of
electricity imposed by the Royal Decree 900/2015 approved by the Spanish
Parliament. As a result, we need to determine if applying technologies that generate
more biogas will result in larger impacts than the current scenario if the biogas
cannot be used for cogeneration.

TH314
Anticipatory life cycle assessment of sol-gel derived anti-reflective coating for
greenhouse glass
N. Tsay, CML Leiden University / CML; J. Quist, Delft University of Technology / Technology, Policy, and Management; A. Wypkema, M. Mourad, TNO / Materials
Solutions; V. Prado, CML Leiden University
In the over 100 years of greenhouse production, technological innovations are being
made to improve the crop yield. This, in turn, generates a demand for higher
performing components. Scientifically, some recent developments in greenhouse
greenhouse glass coatings. The light intensity is essential for the crop growth in the
greenhouses. A portion of the light is lost when it reaches the greenhouse glass
due to the glass reflection. The anti-reflective glass coatings can be applied
on the surface of the greenhouse glass to allow more sunlight to enter the
greenhouses. As a result, more yield of crop could be obtained under coated glass.
The Netherlands Organization for Applied Scientific Research (TNO) is developing
a novel anti-reflective coating for greenhouses which is expected to have higher
light transmittance than the conventional coatings by 2.5%. In this study, three
reference coatings in addition to the novel coating were assessed. The functional
unit was the mass of tomatoes obtained under a certain area of a greenhouse with
uncoated/coated glass during 30 years. The novel coating is being synthesized in
the laboratory scale, and thus, in LCA, What-if scenarios were used to scale-up the
coating system to pilot and industrial scales. The laboratory parameters, e.g. the
amount of electricity used to produce the coating and the solution volumes,
were optimized using literature and expert consultation. The comparative analysis
was carried out through the evaluation of the environmental impact of the
conventional coatings, and this could be due to the simplicity of the coating method applied by TNO. Also, it was revealed that the coatings do not bring significant environmental benefits rather they bring economic benefits in terms of increased yield of tomatoes. Finally, the
sensitivity analysis showed that electricity used for the production of glass has higher
impacts than transmittance or degradation time of the coatings.

TH315
Combine process simulation analysis with Life Cycle Assessment method in
polyurethane rigid foam production
A. Boedigk, M. Fergemla, Università di trieste; A. Bortoluzzi, S. Rondinini, C.
Locatelli, A. Vertova, Università di Milano
Process simulation is a computational technique used in several sectors of process
engineering. It is very useful at design stage, for defining the feasibility of a new
process, as well as in the process optimization stage, where the optimum value of
the production is pursued and, last but not least, in the process analysis stage for
understanding the potential improvement of an existing process. It consists in the
coefficient simulation using algebraic differential equations and the physics of the
process as well as the material and energy balances of the unit operations
involved. The Life Cycle Assessment is a methodology aiming at
analysing the overall life cycle of products, processes or service. In this work, we
will present the analysis of the complete life cycle of polurethane rigid foam from
cradle to grave in tight connection with process simulation methods, thus
considering the characteristics of the conventional processes, such as pressure drop, energy consumption and other, with impact assessment. This
combination will allow us to identify the best solution for the production of
polyurethane rigid foam both in terms of end of life scenery and environmental
impact.

TH316
Life Cycle Assessment of CO2-based Methanol Production using Captured CO2 from Fossil Fuel Power Plants
C. Lee, University College London / Department of Chemical Engineering; R.
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SETAC Europe 28th Annual Meeting Abstract Book
Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach (P)

TH317
Linking failed swim bladder inflation of larval Japanese medaka (Oryzias latipes) after embryonic exposure to 17a-ethinylestradiol, levonorgestrel and diclofenac - a study of key events contributing to impaired swim bladder inflation through a disruption of expression of lefn1 (β-catenin/Wnt transcription factors), but not the expression of the Wnt ligand wnt5b. Thus demonstrating that these compounds may be altering swim bladder inflation through a disruption of β-catenin/Wnt signalling during early embryo development.

TH318
Linking mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol to adverse outcomes in Lemma minor L. Xie, NIVA - Norwegian Institute for Water Research; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; K. Tollefsen, Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Lemma minor is an aquatic plant commonly used in laboratory phytotoxicity testing due to its rapid reproduction capacity, resource-effective exposure format and central function in the aquatic ecosystem. Several standard methods have already been adopted by international standardisations organisations using this species as an ecotoxicological model. Although being highly useful for regulatory purposes focusing on traditional adverse outcomes, these test systems provide only limited information about the toxic mechanisms and modes of action (MoA) and rarely address complex environmental issues such as exposure to multiple stressors. The present study aimed to use selected functional assays in L. minor after exposure to 3,5-dichlorophenol (3,5-DCP) as a model to characterize the toxic mechanisms causing growth inhibition and lethality in primary cultures. The results demonstrated that 3,5-DCP caused concentration-dependent effects in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorophylls content, reproduction rate and frond size are more sensitive to 3,5-DCP compared to other responses as well as reactive oxygen species (ROS) formation, lipid peroxidation (LPO) and impairment of photosynthesis efficiency. Principal component analysis (PCA) indicated that suppression of photosystem II (PS II) efficiency, electron transport rate (ETR), ROS production and LPO, pigments content and growth were strongly correlated while inhibition of oxidative phosphorylation (OXPHOS) which was more closely correlated with growth parameters. A set of conceptual Adverse Outcome Pathways (AOPs) were developed by using Bayesian network model to decipher the causal relationships between stressors and endpoints. The occurrence of L. minor to form a basis for future studies with similar compounds.

Acknowledgements: This research was supported by Norwegian Research Council through its Centre of Excellence (CoE) funding scheme (Project No. 223268/F50).

TH319
Development of adverse outcome pathways for oxidative stressor-mediated reproductive effects in aquatic invertebrates Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; L. Xie, NIVA - Norwegian Institute for Water Research; Y. Lee, Norwegian University of Life Sciences; F. Lyne, Newcastle University; Y. Kasama, D.A. Brede, Norwegian University of Life Sciences / Centre for Environmental Radioactivity; G. Caldwell, Newcastle University; Y. Kasama, D.A. Brede, Norwegian University of Life Sciences / Centre for Environmental Radioactivity; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; G. Caldwell, Newcastle University; Y. Kasama, D.A. Brede, Norwegian University of Life Sciences / Centre for Environmental Radioactivity; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment

Oxidative stress is a common type of stress in living organisms and induced when the production of reactive oxygen species (ROS) overwhelms the endogenous antioxidants defenses. Environmental chemicals as well as conventional pollutants like PAHs, ROS, protein and lipids can be damaged by ROS through oxidation and peroxidation, thus leading to diverse types of adverse effects, such as growth arrest, developmental abnormalities, reproductive failure and lethality. A wide range of oxidative stressors such as ionizing radiation, ultraviolet (UV) radiation, metals and organics are known to induce oxidative stress. The consequences of oxidative stress have been well studied in vertebrates, especially mammalian species. However, for other ecologically relevant environmental species, such as aquatic invertebrates, the knowledge is still limited. The present study was therefore conducted to: develop AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs based on a combination of literature survey and in silico predictions; evaluate the knowledge gaps in the AOPs; and identify research needs. Several standard methods for DNA, protein and lipids have been adopted by international standardization organizations using this species as an aquatic model organism. The laboratory surveys clearly showed that both UVB and gamma radiation caused dose-dependent reduction in reproduction after the exposure. The reproductive effects were correlated with increased ROS production, lipid peroxidation, DNA damage, apoptosis, mitochondrial dysfunction, impaired DNA repair, potential lipid storage, and abnormal ovaries structures and oogenesis in D. magna, thus verifying several KEs in the conceptual AOPs. This study has for the first time systematically linked excessive ROS production to reproductive effects in aquatic invertebrates using the AOP concept, thus providing mechanistic knowledge for future hazard and risk assessment of oxidative stressor-mediated adverse effects in ecologically relevant species.

TH320
Development of an Adverse Outcome Pathway for cardiotoxicity mediated by the blockade of L-type calcium channels L. Margiotta-Casaluci, H. Dusza, I. Moreira, Brunel University London / Institute of Environment, Health and Societies; M.J. Winter, The University of Exeter / Centre for Environment, Health and Societies; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment

A diverse set of chemical compounds, including some pharmaceuticals and
insecticides, have the potential to perturbate the functionality of calcium channels. Among the different types of calcium channels, the L-type calcium channel (LTCC) is responsible for the excitation-contraction coupling of skeletal, smooth, and cardiac muscle. Chemicals that unintentionally block this channel in cardiac cells may impair heart function and health, leading to various cardiac pathologies and predisposing individuals to heart failure. Advancing our understanding of the mechanisms underlying these adverse effects is of paramount importance if we want to develop effective strategies able to accurately predict the cardiac risk posed by chronic exposure to those chemicals. In this presentation, we describe the development of an Adverse Outcome Pathway (AOP) that outlines the series of causally related key events triggered by the blockade of LTCC, and that can ultimately lead to cardiac adverse effects. We discuss the integration of in silico, in vitro, and in vivo evidence to support the AOP development, as well as the application of computational and network biology approaches that may accelerate the identification of relevant key events. Considering the multifaceted role of LTCC in different components of the cardiovascular system other than the heart, we also discuss the importance of applying AOP network considerations to guide a reliable and fit-for-purpose AOP development. This AOP will represent a valuable knowledge base able to guide the identification of key events that are highly predictive of in vivo toxicity, and that can be measured in vitro without relying on animal testing. The knowledge base will also be used as platform to drive future development projects aimed at incorporating additional layers of complexity in the model, and at driving the transition towards a fully quantitative AOP able to effectively support regulatory decision-making and risk assessment.

TH321 Quantification of AOP by Bayesian network modelling: linking 3,5-DCP exposure to adverse outcomes in Lemma minor
J. Moe, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; L. Xie, NIVA - Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

AOPs have gained international recognition as a systematic approach for capturing existing toxicological knowledge to transparently link mechanistic data to toxicity endpoints. Nevertheless, most AOPs are qualitative and not directly suitable for quantitative risk assessment. Quantitative AOPs (qAOP) should define the relationships underlying transition from one KE to the next sufficiently well to allow quantitative prediction of the probability or severity of the AO occurring for a given activation of the MIE. We have started developing a Bayesian Network (BN) model to quantify a recently proposed AOP, which links the mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol (DCP) to adverse outcomes in the aquatic plant Lemma minor. The BN model is based on data from a laboratory experiment exposing L. minor to DCP in 8 concentrations with 3 replicates. The measured response variables include OXPHOS (oxidative phosphorylation), ROS (reactive oxygen species), ETR (electron transfer rate), Fv/Fm (maximum quantum yield of photosystem II), LPO (lipid peroxidation) and number of fronds (leaves). The proposed AOPs a network consisting of three chains with the same chemical stressor (DCP) and AO (fronds number). All AOP components are defined in the BN as nodes with discrete states. Each node is quantified by a probability distribution across these states. The causal links (Key Event Relationships) are quantified as conditional probability tables (CPTs), which determine the probability distribution of a child node conditionally on the probability distribution of the parent node(s). The CPTs are calculated directly from the stored data in this BN version. The BN was run by changing DCP concentration and inspecting the changes in all subsequent nodes. Qualitatively, the model predictions were as expected: increasing the DCP concentration caused reduced OXPHOS, reduced ETR and reduced fronds number. For example, when DCP was increased from 1 to 2 mg/L, the probability of fronds number being in the lowest (worst) state increased from 6% to 30%. Fine-tuning of the intervals of some nodes is needed to make the BN more responsive. Moreover, we will use statistical approaches to obtain more credible CPTs, such as estimation of dose-response curves with uncertainty. Other planned developments include linking the AO to an endpoint with regulatory relevance, and linking the chemical stressor to an Aggregate Exposure Pathway.

TH322 Development of Quantitative Adverse Outcome Pathway (AOP) of Pulmonary Fibrosis with Effectedopedia
J. Jeong, University of Seoul; N. Chatterjee, University of Seoul / Environmental Engineering; S. Choi, University of Seoul / Environmental Engineering; J. Choi, University of Seoul / School of Environmental Engineering

Pulmonary fibrosis (PF) is a chronic and progressive lung disease where the scars are formed in the lung tissues and the air sac in the lungs (alveoli) becomes stiff leading to serious breathing problems. Several substances are identified as inducer of PF, but high cost of inhalation toxicity studies refrain to conduct systemic studies of all those substances. Hence, the regulations of these substances become obscure. To solve this problem, Adverse Outcome Pathway (AOP) concept has been emerged. AOP is a framework that organizes existing knowledge about linkage between molecular-level perturbation and an adverse outcome. To facilitate the development of AOP, OECD launches AOP knowledge-base (KB). In recent years, the application of quantitative AOP (qAOP) which provide dose-response and time-course prediction, has been gaining much more attention in regulatory decision-making field. To develop the AOP of pulmonary fibrosis, in one hand, we made preliminary AOP from literatures, which constitutes the PPARγ interaction as Molecular Initiation Event (MIE), Collagen activation, Inflammation and EMT-Fibrosis activation as Key Events (KEs), and Cytotoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epitheliump cell (Beas2B). Beas2B cell was exposed to CMT/MIT (a biocide which possess potential risk to respiratory systems) at various doses from 0 mg/L to 2 mg/L for various time for 1 to 72 hr. Cytotoxicity and apoptosis was analyzed using various available assays at mid to high through put condition. While, quantitative analysis of the KEs was performed using Effectopedia platform of AOP-KB. For further study, we are planning to do various dose- and time-response test (using qPCR and ELISA) for each potential KEs, so that we can integrate data for building qAOP model with the network between MIE-KEs-AO. Acknowledgement: This work was supported by a grant from the Korean Ministry of Environment through ‘Environmental Health R&D Program’ (201700137001).
Fish model species in human and environmental toxicology (PC)

MOPC01
Fish caging experiment as a tool for in situ assessment of neurotoxic effects of untreated wastewaters
B. Micic, Petnica Science Center/Faculty of Sciences, University of Novi Sad / Department of Biology and Ecology; D. Tenji, University of Novi Sad Faculty of Sciences / Biology and Ecology; S. Sipos, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology; V. Knezovic, Faculty of Sciences / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX; S. Kašarević, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX); I. Teodorovic, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX)

In the framework of F7P project Solutions, the city of Novi Sad has been selected as a pollution hot spot of the River Danube, mainly due to the direct discharge of untreated sewage into the river. Significant biological effects of untreated sewage were previously observed through an in vitro study. To study neurotoxic effects more in details and in realistic ecological context, we conducted fish caging experiment. Common carp (Cyprinus carpio (L.), Cyprinidae) has been selected for the experiment, as one of the most common species in the Middle Danube, genetically well described and economically important. Ten fish per cage were exposed in cages for nine days at three sites on the Danube River: upstream from sewage discharge – reference site, 230 m and 7 km downstream from the discharge and at one site on Sava River (downstream from industrial wastewater discharge near the city of Sabac). After the exposure period, brains were isolated and prepared for gene expression and enzyme activity analyses. The expression of genes encoding for five enzymes were studied: tachykinin 3a and tachykinin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (receptor for the inhibitory neurotransmitter GABA and various drugs), synaptotagmin 10 (integral membrane protein of synaptic vesicles with a role in exocytosis) and myelin basic protein (responsible for myelination of axons and neuroprotection). The activity of acetylcholine esterase, enzyme that terminates action potential transmission in chemical synapses of cholinergic type, was also examined. A trend of slight upregulation for the expression of the genes encoding for tachykinin 3a and tachykinin 3b, GABA a1 receptor and synaptotagmin 10 was observed for all three studied sites when compared to the reference site. The expression of the gene encoding for myelin basic protein was similar at reference site and 230 m downstream from the sewage discharge, but this gene expression was significantly downregulated downstream from the industrial wastewater discharges. Based on this result, myelin basic protein might be potential selective biomarker which can be used to differentiate the effects of these two types of chemical pressure. No significant difference was observed in the activity of the acetylcholine esterase between studied sites. The study is part of the SOLUTIONS project, funded by the EU FP 7 (FP7-ENV-2013-two-stage Collaborative project) under grant agreement number 603437.

MOPC02
Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreochromis niloticus as model
A. Marcato, Sao Paulo State University - UNESP / Department of Biology; C.P. de Souza, Sao Paulo State University - UNESP / Biology; J. Evangelista Correia, Sao Paulo State University - UNESP / Biology; Y. Mueller, RWTH Aachen University / Department of Ecosystem Analysis ESA; T. Rosenberger, RWTH Aachen University / Institute for Environmental Research BioV; S. Schiwy, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Sugar cane vinasse (G. broussonnetii, Gobioides broussonnetii) is among the most productive areas in the South Atlantic. The Ribeira de Iguacu River (RIR) is the major freshwater contributor of the estuary. It carries different classes of contaminants from former mining activities, agricultural areas and urban centers through an artificial channel. The disordered human occupation, presence of boats and the disposal of waste and sewage are also sources of pollution throughout this system. The toxic effect of sugar cane vinasse due to the natural and artificial discharges of vinasse discharge was in river and in summer. In winter, nuclear morphology alterations were identified in erythrocytes more frequently in fishes of Cananéia. The results suggest that contaminants such as metals and HPAs previously reported in the sediments may have been stressing this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall regime and the bioavailability of these contaminants may interfere in their responses. Normal regulatory and endocrine activities was observed near to Cananéia and Subaíma points. It suggests an influence of the local hydrodynamics by dragging the contaminants from the main sources (RIR and Cananeia city) to these areas once lower impacts were seen in Igapó. This last point is located above the artificial channel in an area of low hydrodynamic. Water and sediment chemical analyses are being performed in the studied points in order to support a better understanding of these responses.

MOPC04
Does ozonation of the Aachen-Soers WWTP improve the water quality in the field? Caging experiments with juvenile rainbow trout and various biotopes
Y. Mueller, RWTH Aachen University / Department of Ecosystem Analysis ESA; T. Rosenberger, RWTH Aachen University / Institute for Environmental Research BioV; S. Schiwy, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research

The New Water Framework Directive aimed to achieve a good and chemical biological state of all surface waters until 2015. However, the good biological state is only reached by around 20 % of the German surface water bodies. One reason might be the release of a variety of anthropogenic contaminants by waste water treatment plants (WWTPs) into these water bodies. Additionally, these substances are not sufficiently eliminated via conventional waste water cleaning processes. Nevertheless, these chemicals can have adverse effects on the river biota. The implementation of a further treatment step into WWTP could reduce this burden. There are advanced treatment processes, as the ozonation. At the “Aachen Soers” WWTP a large-scale ozonation plant was installed at the end of 2017. Regular operation will start by approximately March 2018. The “Aachen Soers” WWTP is located near the city of Aachen (North Rhine-Westphalia, Germany) and releases its effluent to the Stream Wurm. At medium and low water levels the stream runs around 70 % treated waste water. To elucidate the impact of the additional waste water treatment on this river the status quo was recorded before the implementation of this treatment step. After the installation of the ozonation the WWTP as well as the Wurm will be monitored for two years. Besides numerous in vitro and in vivo experiments also in situ experiments with different contaminants was conducted. Fish with juvenile rainbow trout (Oncorhyncus mykiss) were used and placed downstream the WWTP. The goal was to evaluate the impact of the WWTP outlet on the river. Further, the impact of the upstream burden was part of the study. Several biomarkers were investigated on different organs of the fish. Detoxification enzymes were investigated in liver tissue and acetylcholinesterase was measured in brain tissue. Furthermore, micronuclei formations counted in blood smears to get information on genotoxic effects. To gain information on endocrine effects Vitellogenin levels were measured in blood plasma and mucus to compare the conventional invasive method with a new non-invasive method. Fish were caged...
during late summer in 2017 to evaluate the status quo of the stream and the performance of the “Aachen Soers” WWTP. This project is funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia.

MOPC05

Environmental applications for medium-throughput, in vivo androgen disruptor identification with the RADAR assay
A. Tindall, A. Phan, N. Roxane, Watchfrog S.A.; B. A. Demeneix, MNHN / CNRS UMR 7221; G.F. Lemkine, Watchfrog S.A.
Over recent years, it has become evident that environmental contamination with endocrine disruptors is not limited to those acting on the estrogen axis. In contrast, large-scale screening of aquatic and terrestrial pesticides have been identified with in silico tools. Two key studies identified 66/200 and 37/134 pesticides tested as anti-androgenic. However, due to the absence of medium-throughput in vivo assays for androgen axis disruption, the effects of many of these pesticides have yet to be confirmed in vivo. We developed a transgenic medaka line harbouring a portion of the spg gene promoter driving expression of GFP. We have previously demonstrated that this line is capable of correctly identifying androgens and anti-androgens, including pesticides, with similar sensitivity to the androgenised female stickleback screen but in a greatly reduced time frame. Using eleuthero-embryonic life stages we developed the Rapid Androgen Disruption Adverse outcome Reporter (RADAR) assay. Extracts of Danube River water from sites upstream and downstream from a major effluent stream from the city of Novi Sad in Serbia was analysed. Comparison of our results to previously published data from four in vitro assays carried out on the same extracts indicated that the effect observed in vivo was two orders of magnitude higher than the in vitro effect, suggesting additional mechanism(s) of action present in vivo in addition to androgen receptor activation indicated by the in vitro assays. Application of the RADAR assay for effect-directed analysis was demonstrated for the rapid in vivo confirmation of environmental organochlorine number of pesticides that had previously been identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo to our knowledge. Powerful anti-androgenicity was observed with the RADAR assay for some of the tested pesticides, confirming the results of the in vitro study. The RADAR assay is a reliable medium-throughput tool which can be applied within a variety of environmental scenarios in order to identify androgen axis disruption, such as environmental monitoring, identification of unknown toxicity drivers and testing of pure chemicals in a REACH context. In addition, this model, based on the use of early life stages non-compliant with the EU definition of a laboratory animal, provides ethical advantages in line with the three R’s principle of animal replacement.

MOPC06

Evaluation of the toxicity of environmental samples collected near vineyard parcels on rainbow trout larvae (Oncorhynchus mykiss) and liver cell line RTL-W1
S. Weeks Santos, EPOC University of Bordeaux; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS SR5805; J. Grussuin, EPOC University of Bordeaux / UMR EPOC; Q. Papin, University of Bordeaux / UMR EPOC; C. Clerandieu, EPOC University of Bordeaux / EPOC UMR B. Morin, University of Bordeaux / EPOC; B. C. Cormier, Université of Bordeaux / EPOC UMR P. Gurvies, University of Bordeaux / UMR EPOC SR5805; J. Cachot, University of Bordeaux / EPOC VITEX. The vineyard use the most pesticides. Aquatic ecosystems are usually the final receptor of all pollutions by leaching, deposition or infiltration; but, because of its capacity of accumulation, sediments represent a reservoir of contaminants larger than the water column itself. As part of this work, we assessed the toxicity of environmental samples, waterborne and sediments, from La Livenne river in hepatic cell lines (RTL-W1) and rainbow trout (Oncorhynchus mykiss) larvae. Samplings were done in La Livenne’s watershed near Bordeaux (Southwestern France), a region with a strong presence of vineyards, over three campaigns in February, May and August 2017. Waterborne and sediment samples were collected in 4 sites from La Livenne (Mennanteau, Parodier, Grand Village and Vignolles) and one site Reguignon from Les Souches (a small stream upstream and downstream from a major effluent stream from the city of Novi Sad in Serbia). Pesticides, including both polar and non-polar pesticides, were detected in all sampling sites and included organochlorines, organophosphates, herbicides and some fungicides that have been banned or restricted for use in the EU. Some of the tested pesticides, including aldicarb and ethiofona, had a moderate toxicity in vitro. They induced in vitro apoptosis and cell death in MOPC05 cells and were confirmed in vivo as potent clastogens. The expression of the p53 gene was significantly increased. These results are in accordance with the toxicity ranked by the RADAR assay. The SAR of environmental samples was ranked, and the highest toxicity was observed in samples collected in La Livenne. Other environmental samples of sediments collected close to vineyards are toxic in vitro and in vivo assays on rainbow trout.

New Horizons in Particular Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (PC)

MOPC07

Optimization and Automation of Raman Microspectroscopy for Microplastic Analysis
P. M. Anger, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; L. Precht, Technical University of Munich / Institute of Hydrochemistry; R. Niessen, Technical University München / Chemistry Department, Chair of Analytical and Water Chemistry; M. Eilsner, N. P. Ivelva, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry
On the one hand, plastics are a most important part of our daily life. Due to their versatile properties, especially their low weight, formability and their low costs they are an ideal packaging material. On the other hand, microplastics (MP) become a great problem in fresh and marine waters. The monitoring of MP contamination is a challenging task. This is due to the wide variability of their shape, size and density. The standard method to characterize MP is the microplastics analysis by atomic absorption spectrometry (AAS). AAS is a powerful technique for the analysis of heavy metals in environmental samples. However, the analysis of MP requires a destructive sample preparation and only allows to determine the total amount of MP. Other methods such as the adsorption of heavy metals by different adsorbents followed by spectroscopic identification are capable of detecting only the heavier MP which are adsorbed to the adsorbents. These methods do not provide detailed information about the size distribution of MP. The development of automated methods for the better assessment of environmental risks arising from MP is required. In the future, the challenges lie in developing automated methods into these samples, especially for the early recognition as resulting from needs to be addressed. Raman microspectroscopy (RM) is a versatile tool for MP analysis.

MOPC08

Preparation of model small microplastics and nanoplastics
G. Balakrishnan Nair, T. Nicolai, C. Chasseneix, IMM L E MANS / Institute of Materials and Molecules of Le Mans UMR CNRS; f. lagarde, Institute of Materials and Molecules of Le Mans / Institute of Materials and Molecules of Le Mans UMR CNRS
Pollution with plastic debris and plastic fragments has recently been recognized as a major water quality problem in fresh and marine water systems. Degradation of plastic debris in the marine environment leads to the formation of microplastics (< 5 mm) and potentially nanoplastics (≤ 1 µm). Recent investigations show that the microplastics can interact with the marine biota. The impact of the interaction on the exposed organism depends on the nature and size of the particles. To acquire more knowledge on these impacts and to optimize analytical procedures, model particles of different sizes and nature of polymers are necessary. However, in the smallest range (< 10 µm), particles of only a few types of polymers are currently available. For this reason, most toxicity tests were realised using PS beads whereas the majority of other particles of different sizes (10-100 µm) and forms (spheres and irregular shapes) were analyzed on different filter materials (e.g. PC, gold coated PC, nitrocellulose, etc.) under different modes of illumination (bright and dark field, fluorescence mode). We found that reflecting filter materials combined with dark field illumination yield superior contrast. Finally, we tested these optimized parameters with samples of different complexity (e.g. environmental samples) and three RM methods: manual-, semi- and automated in regard of particle recognition and automated spectral data evaluation. Samples with a low loading are accessible via an automated approach, whereas the analysis of more loaded samples is better done with manual particle recognition. The results brought forward in this work aim to catalyse advances towards automated methods for a better assessment of environmental risks arising from MP. In the future, the challenges lie in developing automated methods into these samples, especially for the early recognition as resulting from needs to be addressed. Raman microspectroscopy (RM) is a versatile tool for MP analysis.
Environmental Technology
In Norwegian coastal communities, rubber microplastic granules (≤5 mm in size) derived from discarded vehicle tires are used in large quantities on outdoor synthetic turf sports pitches. Through transport by waste water effluents and terrestrial runoff, these rubber particles are considered a significant source of MPs to the marine ecosystem. In the here presented interdisciplinary project we study the compositional degradation and environmental impacts of these rubber granules from locations in northern Norway and Svalbard. Their persistence and residence time in the Arctic marine environment is unknown. These rubber particles pose a potential health risk for arctic wild life through direct ingestion, especially at the base of the marine food chain, but may also provide an exposure route for toxic additive chemicals present in tires to marine organisms. Furthermore, the rubber particles may act as a vector for other persistent organic and heavy metal pollutants already present in the marine environment. Arctic marine environments present special abiotic conditions for the degradation of these particles, with cold water temperatures and long periods with unlimited sunlight. During a 12 months period, rubber crumbs were placed out in the ocean in stainless steel containers and sub-sampled continuously for the measurement of persistent organic pollutants, metals and additives. Hydrophobic persistent organic pollutants such as PAHs, PCBs, DDTs, diphensols, as well as metals were measured to establish the adsorption and leaching kinetics in seawater under in situ conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GC and SPE clean up. Chemical analyses using pyroGC/MS, GC/MS/MS and LC/HRMS were done in the laboratories of NILU, Tromsø and SINTEF, Trondheim. Exposure to demonstrate the detection of nanoplastics in environmental matrices and sorption kinetics of different marine zooplankton species.

MOPC09
Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles
S. Hüpkesberg, V. Zilles, Hochschule Fresenius University of Applied Sciences; T.Courier, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology
Plastic products are nowadays omnipresent as they possess excellent characteristics as raw materials. An increased production and usage of plastic products in the last decades led to an emerging pollution of the environment. Slow or no biodegradability leads to a vector for accumulation of plastic particles in the environment. Plastics can be found in various sizes in the environment, large items were found as well as small particles or debris, which are referred as microplastic (MP) in a size range from 5 mm to 1 mm. In aquatic environments organic pollutants may sorb to MP, which can act as vectors for the sorbed pollutants. It is assumed that polymer material, characteristics of the sorbate, embodiment of MP-particles, biofouling, and adsorption of other substances account for the sorption of humic substances to the polymer surface. (I) Humic substances do not have an impact on sorption in presence of humic substances, due to the sorption of humic substances to the polymer surface. (II) Polymers do not contribute a significant amount to the overall sorption of organic pollutants as majority of them sorbs to sediment which is present in excess. The results of this study should provide a tool for predicting sorption behavior of MPs in environmental freshwater samples. Therefore, different parameters presumably affecting the sorption were investigated or are still under investigation to identify their impact on the sorption of organic pollutants in freshwater systems.

MOPC10
Micronized tire rubber: abundance and distribution within microplastic litter of the Charleston Harbor Estuary, South Carolina, USA
R. Leads, College of Charleston / Biology; J.E. Weinstein, The Citadel / Department of Biology
Microplastics (2±are present on shorelines worldwide. A previous survey of Charleston Harbor, South Carolina, USA reported an average of 591±103 microplastic particles/m² in intertidal sediments, with black fragments suspected to be micronized tire rubber making up ~90% of the particles at some sites. The objective of the present study was to further characterize the abundance and distribution of micropolastics, and in particular, micronized tire rubber, in an effort to identify the sources and pathways into Charleston Harbor. As rivers are thought to be a contributor of non-point and point source micropolastics, three major tributaries of Charleston Harbor—the Ashley River, Cooper River, and Wando River—were surveyed. Intertidal sediment (n=6), subtidal sediment (n=13), and sea surface microplastic (n=3) samples were collected from three sites (upstream, midstream, downstream) along each of the rivers and were analyzed for micropolastics (65-500 µm). Intertidal sediment microplastic abundance ranged from 3-4375 particles/kg wet weight. Sea surface microlayer micropolastic abundance ranged from 3-36 particles/L. Microplastic abundance in intertidal sediments and subtidal sediments differed significantly among rivers (p<0.0001 (intertidal), p=0.02 (subtidal)), while microplastic abundance in the sea surface microlayer did not differ significantly among rivers. Blue microplastic fibers and micronized tire rubber presented the highest burden of identified substances observed, constituting 26.2% and 17.1%, respectively, of total micropolastics collected. Furthermore, micronized tire rubber was collected at every sampling location and in every environmental sample type (intertidal sediment, subtidal sediment, sea surface microlayer). These results suggest that micropolastics in Charleston Harbor originate primarily from non-point sources and that micronized tire rubber is a significant contributor of micropolastic litter in Charleston Harbor. These results are the first to report on the abundance and distribution of micronized tire rubber as microplastic litter in a southeastern U.S. estuary and contribute to the understanding of the worldwide environmental presence of micronized tire rubber.

MOPC11
Crumb rubber in sports fields - Advances in environmental chemistry
D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; C. Halsband, Akvaplan-niva; L. Sørensen, A. Booth, SINTEF Ocean / Advances in environmental chemistry
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (PC)
MOPC12
Nanoplastics analysis with Nano-FITR
M. Meyns, Alfred Wegener Institute; S. Primpke, G. Gerds, Alfred Wegener Institute / AWI - Helmholtz Centre for Polar and Marine Research / Polar Research Centre
The distribution of microplastic particles in marine environments and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the micro scale. This hypothesis is supported by results of our group that were obtained from various environments (e.g. North Sea sediments and arctic ice). A mathematical extrapolation of size dependent particle abundances in the samples returns abundances of up to 3.6 x 10^4 kg^-1 for particles with diameters of 0.5 µm. This circumstance raises concerns as part of the aquatic environment.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (PC)
MOPC17
Neonicotinoid insecticides in surface waters discharging into the Great Lakes of Southern Ontario, Canada
T. Sultana, Trent University / Environmental and Resource Studies; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre Neonicotinoid insecticides (NNIs) are a large part of the global pesticide market, as they are very effective at controlling a wide range of insect pests. In Canada, NNIs are used extensively in agricultural and urban regions of southern Ontario to control insect pests on field and greenhouse crops, orchards, nurseries and woodlots etc. Because of their persistence and high solubility in water, there is potential for NNIs to be transported from agricultural fields into surface waters. The objective of this project was to evaluate the distribution of NNIs in surface waters located in areas of intensive agriculture in southern Ontario, Canada that discharge into the Great Lakes basin; specifically into Lake Erie, Lake Saint Clair, Lake Ontario and Lake Huron. Passive sampling with Polar Organic Chemical Integrative Samplers (POCIS) was the principal monitoring technique. To correct for the effect of environmental factors on the rates of uptake of the target NNIs into POCIS, Performance Reference Compounds (PRCs) were spiked into some of the POCIS deployed at each of the monitoring sites. POCIS were deployed for 2 weeks over two deployment cycles. At each of the monitoring sites, water samples for chemical analyses using pyroGC/MS, GC/MS/MS and LC/HRMS were also collected three times over the deployment period. The sites monitored were located in 5 major rivers and 11 smaller creeks in the Great Lakes basin. Static, renewal
experiments were conducted to estimate sampling rates of NNIs and to estimate elimination rates of PRCs. These experiments were conducted using synthetic water at 15°C over 14 days. Extracts were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) using an AB Sciex QTrap 5500 instrument with electrospray ionization coupled with an Agilent 1100 HPLC. Nine NNIs were detected, but the concentrations varied widely from 2 ng/L to 4.6 µg/L. Flurazepam was detected at concentrations up to 1140 ng/L in watersheds discharging into Lake Ontario. Imidacloprid at concentrations up to 1731 ng/L and thiamethoxam at concentrations up to 625 ng/L were detected in the watersheds discharging into Lake Erie. Overall, these data indicate that NNIs are widely distributed in surface waters in agricultural regions in Ontario within the Great Lakes basin.

MOPC18 Occurrence and removal of antibiotics in municipal wastewater by conventional activated sludge (CAS) and membrane bioreactor (MBR) systems
N. Tran, National University of Singapore / NUS Environmental Research Institute; K. Gitt, National University of Singapore / Civil & Environmental Engineering
This study provided the first and comprehensive data on the occurrence and removal of twenty-one target antibiotics and antimicrobials in a full-scale conventional activated sludge and membrane bioreactor systems in the Southeast Asian region. Nineteen out of the twenty-one target compounds were ubiquitously detected in raw influent samples. Concentrations of the detected EDCs in raw influent samples ranged by several orders of magnitude (e.g. from 23.8 to 43,740 ng/L) depending upon the compound and sampling date. The elimination of antibiotics and antimicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a local WWTP was evaluated and compared. Numerous antibiotics and antimicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIPX), clindamycin (CL), azithromycin (AZT), clarithromycin (CLAR), oxytetracycline (OXY), trimethoprim (TMP), vancomycin (VC), and chloramphenicol (CAP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), lincomycin (LIN) and erythromycin (ERY) appeared to be persistent in the both CAS and MBR systems. Field-based monitoring results showed that MBR outperformed CAS in the elimination of most targeted antibiotics and antimicrobials. The relationship between molecular characteristics of EDCs (i.e. physicochemical properties and structural features) and their removal efficiencies during biological wastewater treatment was also elucidated. Excellent removal efficiencies (>90%) were often noted for compounds with the sole presence of electron donating groups (i.e. phenolic –OH, beta-lactam ring, amine –NH2, methoxy –O-CH3, phenoxo –O-C=H, or alkyl groups). Conversely, antibiotics with antimicrobials with the electron donating groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carboxyl, carboxyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC19 The effect of activated sludge conditions on microplastics biodegradation and transformation products formation
L. Gusmaroli, G. Buttiglieri, Catalan Institute for Water Research ICRA
Microplastics such as pharmaceuticals (PhACs) and endocrine disrupting compounds (EDCs) have been detected in all water compartments and the European Union is therefore updating its legislation to limit the release of emerging contaminants. Nevertheless, several microplastics with the environmental engineering or the predominance of strong electron withdrawing groups (e.g. halogenated, carboxylic, carboxylic, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes. The elimination of antibiotics and antimicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a local WWTP was evaluated and compared. Numerous antibiotics and antimicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIPX), clindamycin (CL), azithromycin (AZT), clarithromycin (CLAR), oxytetracycline (OXY), trimethoprim (TMP), vancomycin (VC), and chloramphenicol (CAP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), lincomycin (LIN) and erythromycin (ERY) appeared to be persistent in the both CAS and MBR systems. Field-based monitoring results showed that MBR outperformed CAS in the elimination of most targeted antibiotics and antimicrobials. The relationship between molecular characteristics of EDCs (i.e. physicochemical properties and structural features) and their removal efficiencies during biological wastewater treatment was also elucidated. Excellent removal efficiencies (>90%) were often noted for compounds with the sole presence of electron donating groups (i.e. phenolic –OH, beta-lactam ring, amine –NH2, methoxy –O-CH3, phenoxo –O-C=H, or alkyl groups). Conversely, antibiotics with antimicrobials with the electron donating groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carboxylic, carboxylic, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC20 Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gilt Head Bream
H. Ziaurra, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; M. Izarola, University of the Basque country UPV/EHU / Research Centre for Experimental Marine Biology and Biotechnology (PJE); A. Prieto, N. Etxebarria, University of the Basque Country UPV/EHU / Plentzia Marine Station (PJE-UPV/EHU) & Dep Analytical Chemistry; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; M. Olhain, O. Zuloaga, University of the Basque country UPV/EHU / Plentzia Marine Station (PJE-UPV/EHU) & Dep Analytical Chemistry
The widespread use of pharmaceuticals has caused a growing concern on the presence of pharmaceuticals such as the antibiotic ciprofloxacin (CIPRO) in the aquatic environment, since they may exert adverse effects on non-target organisms, including fish. In order to study the uptake, distribution in different tissues (liver, muscle, brain and gill) and biofluids (plasma and bile), metabolism and elimination of CIPRO in gilt-head bream (Sparus aurata), controlled dosing experiments for 8 days at 200 µg/L concentration were carried out. CIPRO was only observed in bile, probably due to its low octanol-water partition coefficient and the zwitterionic behaviour. CIPRO by-products (BP) were also identified in seawater environment, both in presence and absence of fish. The analysis done by means of liquid chromatography–high resolution mass spectrometry permitted the annotation of up to 35 BPs of CIPRO in seawater and bile, from which 30 structures were reported for the first time. Up to 20 BPs were annotated in the absence of fish. The phase I degradation products of CIPRO in seawater were oxidation, methylation, oxidative defluorination (in 3 BPs out of 20), reductive defluorination (1 BP out of 20), dehydrogenation of the piperazenyl ring (in 2 BPs) and the cleavage of the amino group of the oxadiazole ring with (1 BP) or without (2 BPs) the loss of the primary amine formed during the cleavage. The only phase II transformation of CIPRO observed was BP18 that, apart from the oxidative deamination of the piperazenyl ring, also suffered the glycine conjugation. 14 of the previously observed BPs were plus 10 new BPs were annotated in water in the presence of fish. Compared to the BPs annotated in the absence of fish, oxidative deamination and both glycine and glutamine conjugation gained importance since 4 of the 10 new BPs had suffered both transformation reactions. Although CIPRO metabolites were searched in gill-head bream liver, brain, muscle, gill, plasma and bile, BPs were only detected in bile. 5 BPs were found and none of them was detected in seawater. While defluorination and oxidative deamination gained importance in bile, neither glycine nor glutamine conjugates were observed in bile BPs. This work was financially supported by the Ministry of Economy and Competitiveness through the project CMT2014-56628-C3-1-R. H. Ziaurra is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.
relevant concentrations in the investigated area and time (above 100 ng/L). As expected concentrations were higher in drainage canals than in irrigation ditches. Measured concentrations were used to evaluate the ecotoxicological risk for the aquatic organisms in this area by means of a hazard quotient-based approach. This work was possible thanks to the Government of Catalonia (2014 SGR 418) and the Spanish State Research Agency (AEI) and the European Regional Development Fund (ERDF) through the project BECAS (grant number: CTM2016-75587-C2-2-R), and to Merck for the gift of LC columns.

**MOPC22**
Degradation kinetics and degradation products of dioclefinac with persulfate J.M. Montagudo, University of Castilla-La Mancha; H. El-talawy, Aarhus University / Department of Environmental Science; A. Durán, J. San Martin, University of Castilla-La Mancha; K. Bester, Aarhus University / Environmental Science

Dioclefinac concentrations in effluent wastewater are often exceeding local limits or upcoming EU regulations. This study was undertaken to explore the possibilities of removing dioclefinac with persulfate in respect to kinetics and reaction pathways. In-situ chemical oxidation of a dioclefinac aqueous solution was performed using persulfate anions activated by ultrasound. The dioclefinac (DCF) removal reaction by the persulfate process and the role of various intermediate oxidative species of persulfate such as hydroxyl, sulfate, superoxide anion or singlet radicals in the removal process as well as to determine a possible reaction pathway was observed. The removal efficiency was highest at pH values below 4.5. In addition, the production rate of sulfate radicals from persulfate was increased with decreasing pH values. A reduction in the reaction rates in the ultrasonic persulfate (US/PS) process was observed with excess persulfate as the reagent decomposed via the non reactive $\text{SO}_4^{2-}$ (with no generation of the very effective $\text{SO}_3^-$). Sulfate and hydroxyl radicals were involved in the main reaction pathway of dioclefinac. Dioclefinac amide and three hydroxy-dioclefinac isomers (3-hydroxy-dioclefinac, 4-hydroxy-dioclefinac, 4-hydroxy-diclofenac) were identified as reaction intermediates. The obtained results demonstrate that the US/PS process could be a potential alternative to remove compounds of emerging concern, such as dioclefinac from wastewater.

**Mercury Biogeosciences - Fate, Effects and Policy (PC)**

**MOPC23**
Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks

D. McLagan, University of Toronto Scarborough / Chemistry; C. Mitchell, University of Toronto Scarborough / Physical & Environmental Sciences; F. Monaci, University of Siena; Y.D. Lei, University of Toronto Scarborough / Department of Physical and Environmental Sciences; F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences

The Minamata Convention on mercury (Hg) stipulates that complete emissions inventories should be established. Passive air samplers (PAS) produce time-averaged concentration data over long deployment periods and are therefore particularly well suited for mapping gaseous Hg concentrations, identifying and locating unknown Hg sources, and quantifying emission rates. We used networks of PAS in both the Greater Toronto Area (MDA) in Canada and the Monte Amiata Hg mining area of Italy to illustrate this approach to Hg source characterization. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radical diffusive barrier to control uptake kinetics. 145 PASs were deployed across the GTA in July and August 2016 for time periods ranging from 34 to 46 days. In Italy, PASs were deployed at two spatial scales (a 0.56 km² square comprising the former Abbadia San Salvador mercury mine and a 41.6 km² square covering the eastern slope of Mt. Amiata. Both squares were divided into a grid of 7x7 cells and a sampling site was selected within each of the 49 cells. The finer spatial resolution grid was sampled twice with one-week long deployments in Oct. 2015 and Jul. 6 2016. The coarser spatial resolution grid was sampled for an entire year (Oct. 2015-Oct. 2016), in four seasonal deployments of approx. 3 months each. Mean gaseous Hg concentrations in downtown Toronto (1.77 ± 0.28 ng m⁻³) were slightly, but significantly elevated relative to other parts of the GTA (1.42 ± 0.20 ng m⁻³). Concentrations at sites close to waste/recycling (1.61 ± 0.22 ng m⁻³) and hospitals/dental facilities (1.63 ± 0.21 ng m⁻³) were slightly, but significantly elevated relative to other parts of the GTA (1.61 ± 0.22 ng m⁻³). The results highlight the importance of photodemethylation to mercury budgets, few studies have been made to estimate the mercury emission from biomass burning to mercury emissions at Cape Point, South Africa

**MOPC25**
Contributions from biomass burning to mercury emissions at Cape Point, South Africa

V.S. Somerset, CSIR / Chemistry; C. Van der Horst, University of The Western Cape / Sensor Lab Department of Chemistry; L.G. Martin, South African Weather Service; C. Walters, CSIR / Natural Resources and the Environment

Mercury (Hg) is known to be a persistent and toxic heavy metal that can bio-accumulate in the aquatic environment and lead to serious human health effects. Hg is released into the atmosphere from both natural and anthropogenic sources, wherein the atmosphere it can be present in a gaseous phase or in particulate matter. Results of work have been published in the literature on the emission of Hg from various sources in southern Africa for the last decade. These studies have shown that the emissions from coal burning are reasonably well documented, with some recent inventories showing Hg results between 40 – 50 t Hg/yr in 2004 to 2006. However, only a few attempts have been made to estimate the mercury emission from biomass burning to the atmosphere in South Africa. This study provides a quantified assessment of the emissions from biomass burning to the atmosphere in South Africa using a biogeochemical modelling approach coupled to atmospheric chemistry models. The results show that biomass burning is a significant source of Hg to the atmosphere with emissions reaching 12,500 ng m⁻³ for a single event from burning of larger fish. This again may result from changes in the population structure (e.g. repeated recruitment failure), or changes in sampling bias. These findings point to the need for uncovering the effect of cod length/age on the mercury concentration trends also on other localities along the Norwegian coast. The results from this analysis is newly finalized and will be presented.

**MOPC26**
Building a predictive model for methylmercury photodemethylation in freshwater ecosystems

S. Klapstein, Acadia University / Earth & Environmental Science; D.A. Risk, St Francis Xavier University / Earth Sciences; S.E. Ziegler, Memorial University of Newfoundland / Earth & Science; N.J. d'Orissol, Acadia University / Department of Earth and Environmental Science

Quantifying why and how some ecosystems are more sensitive to contamination following atmospheric mercury deposition is key to mercury fate modelling. Photodemethylation of MeHg is thought to be one of the main processes that convert MeHg into a less biologically toxic form of mercury [4]. While previous studies highlight the importance of photodemethylation to mercury budgets, few have examined the magnitude of potential primary production of MeHg as a function of associated dissolved organic matter (DOM). DOM absorbs specific wavelengths of solar radiation and therefore MeHg that is bound to these compounds containing photoreactive functional groups may be more readily degraded than unbound MeHg. Alternatively, DOM may shade much of the water column and inhibit photodemethylation. To address this research gap we have used nutrient-controlled and semi-controlled experiments that focused primarily on the quantification of the relationships between solar radiation exposures, DOM, and MeHg within six freshwater lake systems in Kejimkujik National Park and National Historic Site in southwestern Nova Scotia. Using incident irradiation values measured from floating instrumentation the incoming UV-A could be modelled with depth in the lakes as DOM concentration changes. From these numbers we were able to apply our photodemethylation rate constants, derived from controlled experiments, to available UV-A to predict the loss of MeHg based entirely on DOM concentration (Figure 1). In the subset of Kejimkujik National Park lakes that were studied, lakes with higher DOM lost much less MeHg through the
photonemission pathway and a strong seasonal difference due to variation in incoming solar radiation was evident. This model may be appropriate for other aquatic ecosystems by simple standardization techniques depending on water quality characteristics such as DOM photoreactivity (structure, pH), and dissolved ionic species. Overall, this body of work yielded a method for predicting mercury availability to food webs depending on environmental and physicochemical factors. Climate change in temperate and boreal regions of Atlantic Canada is projected to increase rainfall amounts and occurrences and thus lead to browning of freshwaters and further inhibition to the photonemission pathway of MeHg reduction.

MOPC27

Polymer inclusion membranes followed by X-ray fluorescence analysis as a new tool for mercury monitoring in natural waters at low concentration level

G. Elias, University of Girona; E. Margui, University of Girona / Department of Chemistry; S. Díez, IDAEA CSIC Barcelona; C. Fontas, University of Girona / Department of Chemistry

At present, there is a considerable interest in mercury (Hg) monitoring due to its widespread occurrence and high toxicity of most of its compounds. Due to the low concentration levels, the complexity of some natural waters and the poor stability of the metal during sample storage, methodologies overtaking these problems are of main interest. In this context, polymer inclusion membranes (PIMs) can be an interesting tool to help in environmental monitoring. PIMs consist of a polymer, which provides mechanical strength, the carrier, which is the responsible of the extraction process, and sometimes also a plasticizer can be used to provide elasticity. The stability, versatility and easy manufacturing make PIMs as a useful separation technique to be taken into account. In this work, PIMs have been prepared fixing cellulose triacetate as the polymer and the ionic liquid trioctylmethylammonium thiocyanate (TOMATS) as extractant. PIMs were contacted with Hg in natural waters and, once the metal was collected, membranes were fixed, and Hg determination of the obtained solutions was performed by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and Direct Mercury Analyzer on Freeze-dried Membrane Pressures (DFA) system. A calibration curve was obtained in the concentration range of 0.5-10 ppb and the detection limit of 0.07 ppb. The results showed that adsorbed and intracellular Hg concentrations decreased as exposure time increased with respect to exposure in the absence of DOM. However no specific trends in the Hg uptake by phytoplankton, central for its incorporation in the food webs, and in particular the microalgae (Bacillariophyceae and Dinophyceae) commonly found in natural waters were observed. However, bioavailability was increased by the addition of DOM. The implications of the obtained results are discussed further with respect to the prediction of the mercury incorporation at the base of the food-webs and the impact in the environmental systems.

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (PC)

TUPC01

Overview on the risks from fungicides for aquatic organisms

J.P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; J.R. Rohr, University of South Florida / Department of Integrative Biology; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Agricultural Sciences and Assessment; R. Schaeffer, University Koblenz Landau / Institute for Environmental Sciences

As fungal pests are a major threat to crop production, the application of fungicides to control fungal infestations is considered indispensable to secure global food supply. The use of fungicides is forecasted to increase due to altered climatic conditions and invasive fungal species. Following their use, fungicides can enter aquatic ecosystems and, given their typically frequent application, ecotoxicologically relevant levels of fungicides can occur in surface water bodies in agricultural catchments throughout the growing season. However, in comparison to herbicides and insecticides, the fate and effects of fungicides have received less attention. To highlight research gaps, we reviewed the current knowledge on fungicide exposure and mitigation measures. Within aquatic systems, aquatic fungi appear to be particularly at risk of adverse effects because fungicides are designed to control their terrestrial relatives during crop production. Indeed, structural and functional implications of fungicide resistance in aquatic fungal communities have been reported in field and laboratory studies. As fungi (positively (e.g., conditioning of detritus) and negatively (e.g., via parasitism) interact with other organisms, such effects have been shown to result in indirect fungicide effects on other taxonomic groups. In addition, other taxonomic groups can also be directly affected by fungicides because these substances act on biological processes that are highly conserved (e.g., energy production). Direct impacts of fungicides on non-fungal microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action groups that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss current risk assessment procedures for fungicides in the light of identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.
Fungicide effects propagate through the detrital food chain in streams

J. Rasmussen, Aarhus University / bioscience; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; M. Skov Pristed, Aarhus University / Department of Bioscience

Fungicide use in Europe equals that of herbicides, but the amount of studies addressing ecological effects of fungicides is disproportionately low. Recent studies suggest that particularly freshwater fungi may be susceptible to fungicide exposure leading to changed fungal community structure and reduced fungal biomass. These effects may negatively influence the food quality for higher level consumers, e.g. invertebrate shredders. Fungi occur rather continuously in low concentrations in agricultural streams especially during cropping seasons suggesting that long-term chronic exposure scenarios should be covered in ecotoxicological research. We conducted a 5 month stream channel experiment using two environmentally realistic concentration levels of a quaternary fungicide mixture to investigate long-term effects of chronic fungicide exposure of a leaf decomposer assemblage containing fungal communities and two species of caddisfly shredders: Chaetopteryx villosa and Anabolia nervosa. Food availability was additionally manipulated ranging from excessive to limited food availability (three treatment levels). Fungal biomass significantly decreased with increasing fungicide concentrations, and the fungal community structure was significantly different in the highest fungicide treatment compared to the lowest fungicide treatment and the untreated control. Fungal species richness was consistently and significantly lower in the highest fungicide treatment. A dense vegetated and wide buffer strip surrounding surface water bodies, for instance, can be efficient to reduce the spray drift of fungicides during application. Also during run-off, buffer strips have been suggested as a potential measure mitigating fungicide exposure by retaining run-off water and providing sites for adsorption as well as degradation. Under field conditions, however, vegetation density and erosion rills undermine the buffer strips' mitigation potential. Once released into aquatic ecosystems, (constructed) wetland and vegetated systems are considered an effective tool for mitigating a downstream transport of pesticides. The efficiency of such systems depends on both the physico-chemical properties of the pesticide of interest as well as system inherent properties. The pesticides affinity to organic carbon (Koc) is one physico-chemical property driving their retention, with more hydrophobic substances being more efficiently retained. Although fungicides are usually rather hydrophilic, their peak concentrations were also shown to be reduced by such vegetated systems. The systems' efficiency in doing so, is modulated by size related properties as well as plant density. Both parameters are increasing the retention time of fungicides and thereby the probability for adsorption and degradation processes to take place. Mitigating the fungicide exposure via spray drift and run-off may thus efficiently be addressed by a combination of measures. Those measures may include the proper management of vegetated buffer strips. This mitigation measure may be supported by the implementation of vegetated systems (such as constructed wetlands) in situations where catchment characteristics suggest a high risk that cannot be controlled by buffer strips or where such buffer strips cannot be realised.

Towards a better exposure assessment of antifungal azoles

N. Creusot, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; B.J. Ferrari, Centre Ecotox A Chaia-Hernandez, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; B.J. Ferrari, Centre Ecotox EAWAGEPF; S. Fischer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; N. Munz, Eawag / Environmental Chemistry; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; S. Spycher, B. Spycher, Eawag Swiss Federal Institute of Aquatic Science and Technology; C. Stamn, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; P. A. Thili, Eawag / Department of Environmental Toxicology; J. Wittmer, Plattform Wasserqualität VSA; J. Hollender, Eawag / Environmental Chemistry

Antifungal azoles are a class of contaminants of emerging concern since increasing evidences highlight their potential effect on aquatic organisms at different trophic levels, raising the need to evaluate the associated environmental risk. Although a few of these compounds are routinely investigated, an accurate exposure assessment of most of them is still lacking to evaluate this risk. To address this issue, we first defined a list of 60 antifungal azoles including pesticides and pharmaceuticals based on the use/consumption of these compounds in Switzerland and Germany. We then performed a retrospective suspect screening on a set of data acquired with liquid chromatography-high-resolution mass spectrometry (LC-HRMS) from a large panel of environmental samples to completely previously targeted analyses on azoles. Since antifungal azoles are used both as pharmaceuticals and pesticides these samples included wastewater treatment plant effluents (WWTPs), river surface waters, biota from rivers (fish, gammarids, biofilms), river and lake sediments, soils and groundwater from various sites allowing to encompass different sources of anthropogenic pressures. The results revealed that antifungal azoles are widely distributed in aquatic ecosystems (e.g. from

Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems

M. Damm, CENSE & New University of Lisbon, Lisbon; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

In Europe, the EFSA Aquatic Guidance Document describes the procedures for the derivation of regulatory acceptable concentrations (RACs) for pesticides on the basis of tier-1 (standard test species), tier-2 (genotoxic and SSD) and tier-3 (micro/mesocosms) approaches. The consistency of this tiered approach has previously been evaluated for insecticides. In the present study, results of different tiers are compared for fungicides. To this end, laboratory toxicity data and microcosm/mesocosm data were compiled from open data sources supplemented with data from confidential studies conducted for the industry. RACs for tiers 1, 2 and 3 were calculated following the guidelines described in the EFSA Guidance Document. This presentation will discuss i) the consistency of the tiered effect assessment approach for fungicides as proposed in the EFSA Aquatic Guidance Document; ii) the predictive value of acute and chronic laboratory toxicity estimates for observed responses in microcosm/mesocosm tests; iii) problems in using the Geometric Mean approach in the acute effect assessment for fungicides with a biocidal mode-of-action; and iv) the taxonomic groups that should be represented in species sensitivity distributions for fungicides with a biocidal mode-of-action.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiicals and botanicals (PC)

TUPC07

Ecotoxicological studies performed to assess the potential of a yeastlike fungus, Aureobasidium pullulans, and the response of evaluating authorities

C. Donat, bio-ferm GmbH

In the course of inclusion of two strains of the species Aureobasidium pullulans as active substances to be used in plant protection products in Annex 1 of the Directive (EU) 91/414, a data package was developed to assess the ecotoxicity of these yeastlike fungi. Back then no methods designed for the evaluation of microorganisms as active substances did exist. Methods were based upon certain parts of OECD methods (Section 2) and some advise was found in the EPA OPPTS Series 855 Microbial Pesticide Test Guidelines published by US EPA. However, in some test systems it seemed appropriate to work with scientists of the university to find adequate solutions. Hence some additional “unconventional” results like the Flying doctors experiments with bees as well as an avoidance test with earthworms were available. Whereas EFSA identified data gaps, the European Commission decided to include Aureobasidium pullulans to Annex 1 without requiring any additional study. National decisions for the registration of the product varied, some authorities authorized them, whereas others demanded a maximum distance of 30m from surface water. However, it is important to think out of the box by evaluating these products used in agriculture. It is evident that living microorganism are able to proliferate, depending on the local environmental conditions in their micro-niche (influenced by climatic factors as well as microbial population dynamics), it is hardly possibly to simulate all these complex conditions in laboratory trials. Therefore, a quantitative assessment does not seem to be a
scientific sound, since it is not predictable in which quantities, the microorganisms might or might not be present in the environment at certain time points after application.

TUPC08
Ecological testing and risk assessment considerations for microbial active substances
E.A. McVey, J. Wassenberg, Ctb
For some types of biological pesticide active substances, the same testing schemes and methodologies as used for chemical active substances suffice. However, for others (for example, microbial active substances), the unique properties of the substances and resulting risk assessment questions result in the need for a different perspective on the appropriate testing guidelines and programs, as well as different considerations for the risk assessment assumptions and methodologies. Comparing and contrasting the risk assessment theories and available testing methods, it is clear that while some areas of the risk assessment can be translated between chemical and biological actives, the majority require unique and thoughtful innovations to address the risk assessment objectives. This is particularly well illustrated in the ecological risk assessment schemes for microbial substances, where testing should be performed under conditions such that both the (various) test organisms and also the microbial active are in an optimal environment. Unique and unknown mechanisms of action and toxicity may also present, and be dependent upon the exposure conditions. Similarly to chemical actives, exposure estimations with microbials are also highly dependent upon environmental conditions, however, microbial active substances may be bioavailable at much lower exposure levels than most chemical actives. Regardless of these obstacles, some logical and objective recommendations can be made, both regarding testing and risk assessment for microbial active substances. Considerations of microbial active substances in groups based on pesticide mechanism of action and/or organism group may allow development of some generic testing recommendations. Knowledge from both the biological and chemical testing and risk assessment areas should be comprehensively surveyed and utilized to advise appropriate and adequate testing for microbial active substances.

TUPC09
Human and environmental Risk assessment for microorganisms - to what extent?
Biopesticides are an excellent alternative to chemical pesticides, and there is continuously increasing interest with both industry and consumers. The Sustainable Use Directive (SUD: Dir. 2009/128/EC) strongly promotes a targeted use of pesticides that are eco-friendly and where the use of integrated control of pests and diseases where non-chemical measures are preferred. Plant protection products with a microorganism as active substance could be a solution. Microorganisms have to be approved in Europe in order to be used as active ingredients in biopesticide products. Data requirements for pesticides based on microorganisms are available as separate part of regulation EC 283/2013 and EC 284/2013. The Regulation has widened the scope of the data requirement to include exposure conditions. Similarl

TUPC10
Ecotoxicological testing to support the assessment of Microbials
Biopesticides are an excellent alternative to chemical pesticides, and there is an increasing demand in testing and evaluation of these products. This poster focuses on microbial pesticides based on bacteria, fungi, viruses or protozoans as their active substances. Possible adverse effects to non-target organisms (NTO) are rather limited due to the narrow and specific host range of these microbial pest control agents. However, a complete risk assessment demands testing of NTOs, when exposure and risk can be quite neglected. The assessment of microbial biocontrol agents (mBCA) and microbial biological control products (mBCP) is relatively new and approved testing methods are not yet available in the same extent as they are for chemical pesticides. Not only the toxicity, but also the potential pathogenicity/infectivity needs to be addressed. Currently, the data requirements for mBCAs and mBCPs are part of Issue B of the European regulations 283/2013 (mBCA) and 284/2013 (mBCP). Numerous data requirements listed in these annexes were transformed directly from requirements for chemical pesticides and often cannot be adapted to the biological properties of mBCAs. In order to address the data requirements in a feasible manner, the biological properties of the microorganisms have to be taken into account, instead of strictly applying to current test guidelines. It is important to note, that testing is strongly influenced by physico-chemical properties of mBCAs. Microorganisms, i. a. with frequently used co-formulants, are not soluble which results in alteration of the test conditions (i.e. turbidity, O₂-demand, spray layers). Furthermore, organic components of the formulated product (i.e. yeast, starch) may lead to increased fungal growth in soil or test media. Additionally, the need to test at high concentration levels, leading to negative effects of particles (i.e. spores or co-formulants like kaolin) on the test organisms which are not related to the active substance and are difficult to interpret. Differences between OECD and OCSP (former OPPTs) guidelines, and requirements of the analytical verification in the test medium are addressed as part of the development of alternative ecotoxicological testing approaches. The findings of our ecotoxicological expertise presented in this poster can be considered as basis for further discussions in proposing different test designs addressing mBCA and mBCP requirements.
study were much lower than the levels in the previous study in low and mid latitude region, and even those in the Arctic. The trophic magnification factor (TMF) of each POP compound were calculated based on the ratio of stable isotope nitrogen and the log-transformed POP concentrations. Some of the compounds, OCPs, HBCDs and highly chlorinated PCBs and PCNs, showed significantly positive correlations, suggesting biomagnification of the chemicals. DPs, however, showed insignificant variation in the TMF analysis. After the treatment of TMF analysis for aquatic and terrestrial food web models, TMF values showed different trends compared to the TMFs in whole sample model. The inclusion of migrating animal, such as south pola skua and kelp gull, also arose an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Antarctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranes, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranes, complexity of the food web structure, and the overestimation due to migrant animals arose the uncertainties in TMFs, and therefore need to be taken into consideration to interpret the TMF results in this study.

TUPC19 Bioconcentration as the predominant mechanism for fish PCB contamination in alpine lakes.

T. Massel, Universite Savoie Mont Blanc; M. Parga, Universite de Lausanne / Faculty of Geosciences and Environment; N. Cottin, Universite Savoie Mont Blanc; S. Cachera, CISALB; C. Piot, E. Naffrechoux, Universite Savoie Mont Blanc.

Bioconcentration and biomagnification relative contribution to the PCB burden in freshwater fish in alpine lakes ecosystems remain a debated issue. The aim of this study was to identify the relative role of those different processes for two fish species Coregonus lavaretus (European whitefish) and Salvelinus alpinus (arctic char) in one of the heaviest PCB contaminated alpine ecosystem: lake Bourget (France). The 7 indicator-PCB concentration and lipid content of fish filet were measured in European whitefish (n = 89) and arctic char (n = 55) from 2013 to 2016. Potential explanatory variables for differences in PCB contamination levels in fish were chosen to identify the impact of living and feeding habitat (using d13C and the influence of trophic parameters using d15N and body size. Results showed a decrease of PCB burden in fish after the clean-up of the major input source of PCB in the lake and a steady situation since then. Arctic char was found to be significantly more contaminated than whitefish with a mean concentration of 25±132 ng.g⁻¹ w/w and 45±28 ng.g⁻¹ w/w respectively. Individual’s PCB contaminations in both species were not tied to feeding habitats (p>0.05). Trophic position (characterized with d13C) was also not correlated with intra-species concentration variabilities for the char and was only slightly positively related to concentration variabilities for whitefish (p=0.04), dismissing the importance of biomagnification as PCB accumulation process. However, fish body size seemed to be a potential explanatory variable for individual’s PCB concentration discrepancies in arctic char (p=0.002) and whitefish (p=10). This last observation could be explained by fish/water partitioning equilibirum to be reached, where fish would tend to accumulate more PCB through their lifetime, highlighting the effect of the biocaccumulation process. A lower clearance rate due to changes in physiological parameters (lower gill/body weight ratio, lower metabolism and/or excretion rate) could also be involved.

TUPC20 The role of diet and age: organohalogen accumulation in an avian top predator.

M.E. Loseth, The Norwegian University of Science and Technology / Biology; N. Bries, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; T. Nygård, T.V. Johnsen, J.O. Busnæs, Norwegian Institute for Nature Research NINA; D. Herzke, NILU - Norwegian Institute for Air Research /FRAM Centre Tromsø; G. Pomá, G. Malarravann, University of Antwerp / Toxicological Center; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; B.M. Jenssen, Norwegian University of Science and Technology / Biology; V. Jaspers, Norwegian University of Science & Technology / Biology

Occupying a high trophic level, the white-tailed eagle, WTE, Haliaeetus albicilla can accumulate a wide range of organohalogenated contaminants (OHCs), even at an early age. Their diet consists mainly of fish and seabirds; thus, a long food chain potentially resulting in biomagnification of OHCs. The nests can be exposed to high levels of OHCs through maternal transfer from the egg, and later through the diet. As nestlings develop and grow, concentrations of maternally derived contaminants are diluted. Few studies are accounting for the biological factors of age and body mass on the contaminant accumulation. Samples were obtained in 2015 and 2016 from 70 WTE nestlings from two archipelagos in Norway, Smøla and Steigen. In total, 14 polychlorinated biphenyls (PCBs), 7 organochlorinated pesticides (OCPs), 5 polybrominated diphenyl ethers (PBDEs) and 8 per- and polyfluoralkyl substances (PFASs) were quantified in over 50 % of the analyzed plasma samples at each location and year. The WTE is a marine top predator; however due to the topography of the island Smøla WTEs may feed on a mixed terrestrial and marine diet. According to our preliminary analyses, WTEs in Steigen are feeding on a slightly higher trophic level than WTEs in Smøla WTEs, and may consequently accumulate more of the ingested OHCs. However, in our analyses the SI values were only important in explaining variation in PCBs and not PFAS levels. We also observed that age at sampling is an important factor, as legacy POPs are decreasing while PFASs are increasing with age. However, there are differences between years at each location with higher OHC concentrations for Steigen in 2015 and Smøla in 2016, not explained by age or diet. Our analyses also demonstrate large variations within and between both locations, suggesting that siblings may not always share prey. We hereby emphasize the importance of ecological and biological variables when investigating OHCs in an avian top predator.

TUPC21 Fate of PAH, phthalates and their metabolites in an urban river food web.

A. Friedmann, F. Alliot, EPHE / UMR Méthos; H. Budzinski, University of Bordeaux; M. Chevreuil, EPHE / UMR METIS 7619; R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; P. Labadie, UMR CNRS / EPOC Université Bordeaux / UMR 5805 EPOC.

Trophic magnification factors have been extensively assessed for persistant organic pollutants, but remain poorly studied for metabolizable pollutants and their metabolites. Polycyclic aromatic hydrocarbons (PAHs) and phthalate plasticizers are continuously released in urban rivers and are rapidly metabolised and excreted by freshwater organisms, thus limiting their bioaccumulative potential. Abiotic and biotic samples, from primary producers to piscivorous fish, were collected in an urban river and analysed for PAHs, phthalates and their metabolites. Stable isotopes of nitrogen were used to determine trophic levels and to calculate trophic magnification factors (TMF) of each compound and its associated metabolite. Our results highlight a trophic dilution (TMF < 1) of all PAHs and phthalates, meaning that predators were less contaminated than their prey. When taking into account the associated metabolites, total body burden of PAHs still declined with increasing trophic levels, confirming the rapid transformation and excretion of these compounds within organisms and a very limited trophic transfer. In contrast, the level of phthalate compound and its associated metabolite(s) increased from prey to predators, suggesting a lower clearance rate of phthalates and a slight biomagnification potential across freshwater food webs. At the light of these results, it appears essential to consider phthalate metabolites, instead of phthalate diesters only, in environmental risk assessment.

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (PC).

H. Littler, University of Exeter / Biosciences College of Life and Environmental Sciences; L.V. Laing, University of Exeter / Biological Sciences; R. Boreham, M. Griffiths, University of Exeter / Biosciences College of Life and Environmental Sciences; M. Trenzadel, University of Exeter / Biosciences; J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; G.C. Paull, University of Exeter; R. van Aarle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences

Bisphenol A (BPA) is a commercially important chemical used in the production of widely used epoxy resins and polycarbonate plastics and it is ubiquitous in the environment, resulting in widespread exposure of humans and wildlife. BPA was shown to cause reproductive effects via disruption of both the oestrogen and androgen signalling pathways. Recent studies suggest that BPA also affects epigenetic signalling pathways, including alterations in transcription of DNA methyltion maintenance enzymes and altered DNA methylation profiles. This study aims to investigate how previous exposure of adult fish to BPA affects their response and the response of their offspring upon re-exposure, and whether there is an epigenetic basis for these effects. Breeding groups of zebrafish (Danio rerio) were exposed to 10 and 100µg BPA/L for 5 days, either once (C-10, C-100) or twice (10-10, 100-100) with a 13 day period of depuration in between, and appropriate controls were maintained in parallel. The adult gonads were sampled for transcriptional analysis. Reproduction was quantified over time, and embryos from each treatment group were then exposed to a range of BPA concentrations from 0-72hpf to measure their susceptibility to BPA exposure. There were no effects on reproductive output under our exposure conditions. However, at the transcriptional level, anti-Mullerian hormone (amh) was significantly downregulated only in fish receiving a repeated exposure to BPA (100-100). In addition, embryos originating from adults which received a pre-exposure to BPA (100-100) were significantly more tolerant compared to embryos originating from
naive adults which received a single exposure to BPA (C-100). This suggests that pre-exposure of adult fish leads to a protective effect on their offspring. We hypothesise that these effects may be due to physiological changes or epigenetic memory between the first and second exposure period, and we will now analyse the promoter DNA methylation of amth to investigate this hypothesis.

**WEPC02**
Zebrafish as a model to assess transgenerational effects of environmental stress via epigenetic inheritance
J. Kamstra, NMBU / BaSam

Although toxicological effects of anthropogenic stressors present in the environment are studied extensively, few studies assess the epigenetic effects of such stressors on development and the effects on multiple generations. It is hypothesized that some stressors are able to change the epigenetic state in germ cells causing effects on histones modifications, DNA methylation and miRNA expression, potentially inherited by subsequent generations. Here, the aim was to elucidate the role of epigenetics in transgenerational inheritance of effects of different stressors by measuring all epigenetic layers using the zebrafish model. Transgenerational studies were performed with three different stressors; a DNA methylation inhibitor, 5-azacytidine (5AC); a phthalate metabolite, mono2-ethylhexylphthalate (MEHP) and ionizing radiation. We employed state-of-the-art techniques to assess effects in multiple generations of zebrafish embryos and larvae at all epigenetic layers, but most extensively on DNA methylation. Following early life exposures to 5AC and MEHP, many changes of DNA methylation were found in F1 offspring. While these changes could be linked to gene pathways that are associated to those compounds, such as embryonic development and obesity. Subsequent analysis in two following generations lead to the conclusion that some regions were persistently changed. Concerning ionizing radiation, in F1 embryonic offspring from irradiated parents, many changes of DNA methylation were observed. These changes could be linked to effects that were observed in the occurrence of such DNA damage. Follow up analysis in the second and the third generation, revealed persistent effects of DNA methylation in a number of regions. Additionally, miRNA analysis in the offspring revealed a number of differentially expressed miRNA linked to similar pathways as with the DNA methylation dataset. Finally, changes in histone modifications were found at specific loci, but these changes were not observed in the second generation. Our results reveal considerable effects on DNA methylation following exposures during early life in zebrafish to MEHP, 5AC and ionizing radiation, as well as a role for miRNAs and histone post translational modifications for the latter. By linking the DNA methylation data to genes, results indicate a functional role for DNA methylation in zebrafish. Persistent effects in F2 and F3 implies that DNA methylation changes can be inherited by multiple generations.

**WEPC03**
Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations?
N. Heremans, Belgian Nuclear Research Centre (SCK-CEN) / Biosphere Impact Studies; S. Gaschak, Chornobyl Center; K. Nanba, Institute of Environmental Radioactivity; R. Nauts, SCK-CEN

In this study the impact on plants of long-term (transgenerational) exposure to radiation coming from nuclear accidents like Fukushima and Chernobyl is investigated and compared with lab experiments in either a chronic, acute, multi-, or single exposure to radiation. While in those cases no changes in DNA methylation could be the basis of transgenerational changes found in field or lab conditions. A field campaign was performed in both Chernobyl (CEZ) and Fukushima affected areas (FEZ) in the course of May 2016. Annual Brassicaceae plants, Arabidopsis thaliana and Capsella bursa pastoris in CEZ and FEZ, respectively, were sampled alongside a gradient of enhanced radiation ranging from 0.5 to 50 µGy.h⁻¹. Seeds from Arabidopsis thaliana were harvested in the CEZ and grown for one clean generation under lab conditions to score for multigenerational effects. In addition further lab experiments were performed on wild type plants of Arabidopsis thaliana grown under chronic exposure conditions (at 1 mGy/h) or more acutely (20 to 400 mGy/h) for 14 days in one, two or three generations. Plants were scored for their morphology, photosynthetic capacity and oxidative stress markers as well as germination rate and root growth. In general higher differences are found in plants exposed in a multigenerational setup than in a transgenerational one. The field plants did not show any abnormalities that could be correlated with the exposure gradient although some delay in flowering was observed in plants from mid to high and radiation levels. The level of total DNA methylation could not be linked to exposure gradient present in the field but rather to differences in developmental stage of the collected plants. In lab-exposed plants however global DNA methylation showed a significant increase which was both dose and generation dependent. Significant changes in transcription of methylation regulating genes were also measured in the different generations. Highest differences were present in the S1 generation but seemed to be reduced in the S2 generation. Overall the data hint towards a role of methylation in the response to radiation but its use as marker of exposure or in risk assessment needs further experimental evidence and discussion. This work was supported by European project COMET (7th PCRD EURATOM Contract Number: Fission-2012-3.4.1.604794) (www.comet-radioecology.org)generation.

**WEPC04**
Evolutionary toxicology: tools to understand impacts of past, present and future environmental contamination
S. E. Crawford, RWTH Aachen University / Institute for Environmental Research, Department of Environmental Toxicology; O. D. Olden, RWTH Aachen University / Department of Ecosystem Analysis; M. Hinderer, Technische Universität Dormstadt / Institute for Applied Geocience; A. Schwabl, Technische Universität Braunschweig / Institute for Geosystems and Biodiscindication; H. Hollett, RWTH Aachen University / Institute for Environmental Research

This research will utilize environmental reconstruction methods along with palaeoecological, palaeontological, and palaeogenomic techniques to understand historical, current and potentially future trends in environmental contamination and associated impacts on lake systems. Long-term exposure to environmental contaminants can cause genetic adaptations in exposed populations of aquatic organisms. The new research fields of evolutionary toxicology and resurrection ecology offer powerful tools for the investigation of changes in sensitivities and adaptive trajectories of populations exposed to contaminants and environmental stressors over decades to centuries. Dormant resting eggs produced by Daphnia species (Crustacea: Cladocera) as a result of unfavourable environmental conditions are archived in sediments and can be dated and hatched to produce clonal lineages (i.e., same genotypes) of historical populations. This talk will present an overview of the evolutionary tools available and their current and potential use in toxicological investigations. Additionally, we will present our preliminary research, which examines how genotypes of clonal lineages of Daphnia species from single populations, separated through generations of evolution, differ in their response to exposure of stressors. Results will provide insight into the sensitivity and fitness of organisms in response to environmental contaminant exposures and the micro-evolutionary adaptations of genes that evolve in response to contamination. We will examine if the hypothesised evolutionary changes in aquatic organisms can also result from other environmental stressors, such as temperature. Since increased temperatures are expected to occur in the future as a result of predicted climate scenarios, it is important to examine the fitness of historical and recent clonal of Daphnia to temperature changes in combination with other stressors. We will further assess if toxicological and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.

**WEPC05**
Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations
P. Inostroza, University of Gothenburg / Effect Directed Analysis; I. Vera-Escalona, Dalhousie University / Biology; A. Wicht, Eberhard Karls Universität Tübingen / Chemistry; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Environmental Toxicology; H. Norf, Helmholtz Centre for Environmental Research GmbH - UFZ / River Ecology Aquatic Ecosystems Analysis and Management

Organisms are rarely exposed to only single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecking, founder effects, and loss of genetic diversity. Furthermore, evolutionary change in aquatic organisms can also result from other environmental stressors, such as temperature. Since increased temperatures are expected to occur in the future as a result of predicted climate scenarios, it is important to examine the fitness of historical and recent clonal of Daphnia to temperature changes in combination with other stressors. We will further assess if toxicological and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.

**WEPC06**
Histone methylation as exposure biomarker of environmental chemicals
Observatory for Nanomaterials (EUON) [1] via a delegation agreement in
with the creation, management, and maintenance of the European Union
a perception that there is insufficient information available in the public regarding
substances, including nanomaterials. In addition, the regulations nevertheless address all chemical
requirements for nanomaterials, the regulations nevertheless address all chemical

Elwan, V. Amenta, European Chemicals Agency  ECHA
A. Sumrein
platform for communicating information on the safety of nanomaterials

WEPC09
Roadmap for the unknown
M. Luitwiler, M.H. Wegelmans, Bioeart

The main environmental themes have been addressed in the last decades. Think about acidification, nutrients and bulk industrial chemicals for which
environmental guideline values have been derived within legal frameworks.
changes are ongoing in the scale level at which environmental problems are regarded as well as the scale level of industrial production. In the past large volumes of
bulk chemicals were produced, now and in the future lower volumes of more specialised
compounds are and will be produced. That means that more and more
compounds will enter the environment in lower volumes. Also time-to-market of new
developments and technologies decrease which leaves less time for a thorough risk
assessment. last but not least, techniques for measuring compounds are improving.

What's your take on communication? Don't Panic! Reports on
how to accurately communicating science and risk (PC)

WEPC07
Dangerous misconceptions - Consumers need help!
U. Kwacsha, University of Applied Sciences
Previous surveys revealed that average consumers and even more ill
informed people are struggling with risk communication instruments for harmful substances in
commodities. The majority of consumers do not understand risk communication instruments as intended by legislators or do not use them at all. In contrast, the
present survey focused on 'best-case' consumers who are interested in the topic,
have a good education or a good self-reported knowledge in chemistry. These
'best-case' consumers use preferentially hazard pictograms in accordance with the
Regulation on Classification, Labelling and Packaging (86%), reports in the media
(80%) and information printed on the products (77%) to learn about harmful
substances in consumer products. Surprisingly, smartphone applications (<10%)
and information by authorities (14%) were not indicated as frequently used
information sources. Most respondents considered information published by consumer and environmental organizations (75%) and the hazard pictograms (74%)
as trustworthy. Interestingly, the respondents considered legislators (94%),
consumers (75%), manufacturers (71%) and environmental and consumer
organizations (61%) as responsible for risk reduction. It is alarming that many of
these 'best-case' participants assumed that food (up to 62%), products with an
environmental label (36%), natural personal care products (36%), homeopathic
products (30%), natural pharmaceuticals (26%) and products without hazard
pictograms (11%) would not contain substances harmful for health or the
environment. Nearly one out of ten respondents did not know that consumer
products can contain harmful substances. These results show that motivation
and knowledge in chemistry help, but are not sufficient. Consumers need support to understand these risk communication instruments they need support to understand which
products might contain harmful substances, they need support to determine the
impact of harmful substances in commodities and they need support for suitable
risk reduction behavior.

WEPC08
The European Union Observatory for Nanomaterials (EUON): A new
platform for communicating information on the safety of nanomaterials
A. Sumrein, European Chemicals Agency (ECHA); J. Holmqvist, T. Aitasalo,
Norwegian Geotechnical Institute / Natural Hazards; J. Van Well, M. Zetterlund,
Swedish Geotechnical Institute; G. Ellen, R. van der Brugge, DELTARES; J.
Koerth, B. Vollstedt, Christian Albrechts University of Kiel
The impacts of climate change are broad and although much focus has been on
disaster risk reduction and coastal management, climate change will also have
consequences for environmental management where the transport of contaminants,
organism acclimation and vulnerable communities will be important to consider for future
human and ecological risk assessments. In this context it is useful for environmental
scientists to be familiar with the concept of climate services which are defined as the transformation of climate-related data into products (trends,
assessments, best practices) in relation to climate that may be of use for the society at
large. Since the climate service sector is relatively new, there is a need to engage
knowledge providers, users, and translators to identify improvements to climate
services through co-design, co-development and co-evaluation. The EVOKE
project aims to address this challenge by re-framing the risk and uncertainty
associated with climate data into knowledge products more understandable and
useful for end-users concerned with risk mitigation and adaptation. The project
team will engage end-users in a Living Labs approach to ensure a user-contribution
innovation methodology at established case study sites in Norway, Sweden,
Germany and the Netherlands. The Living Lab methodology has emerged in recent
years as a form of experimental and potentially inclusive mode of urban planning. Although the scope and character can vary depending on the issue at hand,
the institutional level and type of the problem, the general idea is to involve a
range of committed stakeholders in a real-life “laboratory” setting to test and develop
alternative solutions for complex challenges, such as climate adaptation. The
first activity for the Living Labs at each case study site will be a co-design
process to encourage stakeholders to share their perceptions of risk and uncertainty.

WEPC11
Communicating monetary values of environmental impacts - case studies
related to ISO DIS 14044
B. Steen, Chalmers University of Technology; K. Hallberg, AkzoNobel; P. Hanarp,
Volvo Group; J. Lindberg, IVL Swedish Environmental Research Institute; E.
Rise, Essity; M. Romare, IVL Swedish Environmental Research Institute; T.
Rydberg, JVL. Swedish Environmental Research Institute; A. Wikström, Chalmers
University of Technology

Monetary valuation of environmental impacts from human activities is a way of understanding and communicating its societal significance. However, monetary values are easy to accept without knowing the many ways they can be determined and the many perspectives they may represent. ISO TC 207/SC1 has set up a working group to develop a framework standard on monetary valuation of environmental impacts and related aspects (sensitivities and use of resources) to increase transparency and its use in management. The standard contains requirements and recommendation on how to document and report information (metadata) about what a monetary value represents and how it is developed. As a part of the Swedish contribution to the work, three case studies were made to test the framework and to find out which metadata that had the greatest influence on decisions made. The cases represented three different ways to produce energy, one between natural gas and waste and heat from waste incineration, one between different vehicle propulsion techniques, and one between different ways of sludge treatment and energy recovery. We have used the EPS 2015dx method to value emissions and resources and a national Swedish database used for cost benefit studies. The results indicate that the impact evaluation is a complex task and that important metadata to report is the system boundaries of the impact valuation i.e. which impacts on which environmental goods and services that is included in the valuation. The system boundaries of impacts may vary in time, and object that is valued. The object may be chosen anywhere in a cause–effect chain. System boundaries also exist for the population whose values are assessed, and for the emissions and resources used. One mega ton has public influence. Then the choices matters and other assumptions relating to future conditions. The cases, where the alternatives mainly differ due to more or less use of fossil fuel is rather insensitive to how the valuation was made with respect to the ranking of alternatives. In cases where there is a trade-off between use of fossil resources and scarce metals, the choice is very sensitive to the temporal system boundary of the impacts and affected population. A database format is proposed for documenting monetary values and related metadata.

WEPC12

Full STEAM Ahead: Merging Science and Communications to Investigate Environmental Questions

G.K. Biedenr-Prayer, Jacksonville University / Chemistry; A. Kent-Willette, Jacksonville University / Communications; M. Simmons, Jacksonville University / Biology and marine sciences

This project involved a case study and best practices surrounding successful STEAM interdisciplinary research. The collaboration was fostered through events at benefit studies. The results involve a two year research agenda. The study focused on graduate and undergraduate interdisciplinary research in the fields of Environmental Science and Communications. Specifically, the influence of changing land use along the lower St. Johns River, Fl. was investigated, and the project and resulting data were publicized using modern communication tools such as social media, in tandem with more typical scientific means such as presentations and publications. The project will discuss how the collaboration lead to grants and ultimately secured funding, successfully incorporated service learning and research opportunities for students, pursued and communicated meaningful research and managed teaching across very different disciplines.

WEPC13

Let’s go visual, a picture is worth a thousand words: How to explain Emerging Contaminants using animations

N. Osupina-Alvarez, S. Schneider, University of Potsdam / Institute of Earth and Environmental Sciences

The development of new technologies has enhanced the use of several elements in information and communication technologies, semiconductors, electronic displays and ‘green energy’ related technologies. Platinum, indium, thallium are good examples of those kind of elements, that during long time were laboratory curiosities but that now have an important place as raw materials in high-tech products (optics, electronics, medicine). However, many of these elements are toxic (e.g. thallium, Chlaurine) and environmental changes can affect them to the extent that their availability in the environment. Basic research about Technology-Critical Elements (TCE) and Emerging Contaminants (EC) is needed, but also is part of the research process to transfer this knowledge to a general public. Within this framework, the University of Potsdam and GeoEd (http://geoeducation.de/) started a pilot project to develop teaching and learning materials related to emerging contaminants in the environment. In this presentation, we will show how a complex topic, can be easily included in modern science classes, going from a general concept (TCEs and EC) to a particular study case (phytoextraction of thallium from soils using mustard plants). All the material produced implements the Open Educational resources (OER) concept, which aims towards free access, documents with open license and media useful for teaching, learning, as well as for research purposes. The OER concept allows to new initiatives and projects, produce educational material accessible without time-wise or spatial barriers. Acknowledgment: This project is supported by an Outreach Grant of AXA Research Fund (Paris, France) and the Research Focus of Earth Sciences (RFES), University of Potsdam (Germany).

Key words: Emerging Contaminants, Technology-Critical Elements, raw materials, science animations, outreach

WEPC14

Improving transparency, consistency and efficiency of ecotoxicological testing methods using digital textbooks and technology

C. van Gester, Vrije Universiteit Amsterdam / Ecological Science; N. van Straaten, Vrije Universiteit Amsterdam / Department of Ecological Science; T. Hamers, VU Amsterdam University, Institute for Environmental Studies (IVM) / Department of Environment and Health; S. Moeis, Vrije Universiteit Amsterdam / UBVU; M. Kraak, University of Amsterdam / IBED-FAME; J. Parsons, University of Amsterdam / IBED-ELD; S. Droge, University of Amsterdam/IBED Institute / IBED; J. Hermes, Utrecht University / Institute for Risk Assessment Sciences; M.G. Vijver, CML Leiden University / Conservation Biology; N. van den Brink, Wageningen University / Dept of Toxicology; A.M. Ragas, Radboud University / Department of Environmental Science; A. Lohr, F. van Bellenheim, Open University.

Although several textbooks are available, teaching environmental toxicology in general seems to suffer from a lack of a well-elaborated, up-to-date and consistent textbook that covers all aspects of the field. As a consequence, every university is developing its own training materials in addition to a textbook, but only little of this material is available online. And if materials are online, they are not consistent, lack novelty or do not cover the entire field. A Dutch consortium therefore took the initiative to develop an open online textbook on Environmental Toxicology that should cover the field in its full width, including aspects of environmental chemistry, ecotoxicology, toxicology and risk assessment. The initiative is sponsored by the Netherlands Ministry of Education. The project aims at developing an online open access book on Environmental Toxicology that is useful for training at BSc, MSc and higher levels. The book will be designed in a modular way, with each module having a clear teaching goal/assignment level and flanked with a number of keywords. The book will also contain tools for self-study and training, like exercises and questions. With the book, we aim at improving quality, continuity and transparency of the education in environmental toxicology. We also want to make sure that fundamental insights on fate and effects of chemicals gained in the past are combined with recent approaches of effect assessment and molecular analysis of mechanisms causing toxicity. To guarantee quality of the book and associated training materials, we aim at having 1-2 authors for each module and also 1-2 reviewers from outside the team of authors. In addition, an advisory board will be involved in supervising the project, as well as educational advisors, while the project team will serve as an editorial board. The project team, consisting of 6 environmental toxicologists and chemists from six Dutch universities, does not possess all expertise to cover the width of the field. We therefore solicit contributions from as many colleagues as possible from within the SETAC community. With that, we hope we can produce a book that is written and supported by SETAC, that is covering the entire field, and is useful for training within e.g. the SETAC Europe Certified Risk Assessor (CARA) programme. The publication as an open online book will allow continuous updating of the book, providing a possible role of SETAC in sustaining the book.

WEPC15

Policy learning through professional forums in the field of environmental toxicology: What role for the Society of Environmental Toxicology and Chemistry (SETAC)?

M. Mondou, McGill University - Macdonald Campus / Dept Natural Resource Sciences; G. Hickey, McGill University - Macdonald Campus / Natural Resource Sciences; S. Maguire, McGill University; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences

Leveraging more than a hundred years of experience and knowledge (Gallo 2008), modern toxicology has crystalized in a set of highly codified and standardized practices that are used by industry and regulatory agencies internationally to assess the risk of chemicals to the environment. Toxicity testing methods using whole animal studies have long provided the general framework of instrumental beliefs concerning the most appropriate way to pursue the goals of environmental toxicology. While such in vivo methods are useful for determining the acceptable levels of single chemicals in the environment, they have a number of limitations that are broadly accepted within the profession. Most significantly, conventional in vivo methodology and testing methods are useful for determining the optimal policy outcomes that are increasingly being acknowledged by all stakeholders. For example, the general public and regulatory agencies are being forced to overlook the potential effects of most chemicals in the environment due to a lack of data. On the other hand, the chemical industry is being frustrated by slower access to potentially lucrative markets. Beyond human welfare concerns, the welfare of test animals is also a major consideration, particularly for groups mobilized around the issue of animal rights. Alternative testing methods are being increasingly available, such as using in silico computational models and in...
vitro cell- or genomics-based testing strategies (Waters and Fostel 2004). For more than a decade, these alternatives have been discussed and debated in a range of high profile forums (National Research Council 2007) as offering potential answers to the various challenges facing chemical risk assessment. However, the accepted regulatory approaches to determining the risk of chemicals in environmental toxicology have remained, for the most part, unaffected. This poster explores the role of SETAC in policy learning using primary survey data collected from participants in previous SETAC forums. We will summarize the instrumental approach and core policy beliefs concerning alternative testing methods of respondents and assess their self-reported policy learning experiences at SETAC. We will then consider the significance of SETAC as a professional forum through which policy actors learn and adapt to emerging challenges in regulatory science.

WEPC16 SETAC Science and Risk Communication Interest Group T. Seiler, RWTH Aachen University / Ecosystem Analysis

Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WEPC17 Biochar-mortar composites for construction materials S. Oh, T. Seo, University of Ulsan / Department of Civil and Environmental Engineering; Y. Soo, University of Ulsan / Civil and Environmental Engineering

Feasibility of biochar for construction material was examined through synthesis of biochar-mortar composites and evaluation of their construction and environmental properties according to mixing ratios. Characterization of biochar-mortar composites showed that 3-5% biochar inclusion did not significantly change their flowability, compressive strength, and thermal conductivity. As biochar content increased in biochar-mortar composites, benzene concentration in air was accordingly reduced, suggesting that biochar may be favorable to remove toxic contaminants causing sick building syndrome. Toxicity characteristics leaching procedure (TCLP) and Micotek® bioassay tests showed that biochar-mortar composite were not toxic. Our results suggest that biochar-mortar composites may be promising environmental-friendly materials for building and infrastructure construction area.

WEPC18 Complex Formation Trends of Ligand Binding toward In(III) and Ge(IV) D. Wondrousch, G. Schuermann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

In recent years, the demand for strategic elements such as Indium and Germanium has increased due to strong global economic growth, especially in the realm of semiconductors. Dwinding resources and growing demand necessitate new recycling strategies and the reassessment of existing repositories in the light of newly developed technologies. In this context, QASR methods can be utilized in the development of chemical affinity toward strategic elements. Through this, novel ligand concepts can be rapidly assessed and synthesis can be prioritized toward promising ligands, resulting in a shortened development cycle and reduced research costs. In our quantum chemical study, we analyze a system of set of chelators with respect to their complex formation energies toward selected In(III) and Ge(IV) complexes. Following a first principles approach, both Density Functional Theory and higher levels of theory have been used for the calculations, also addressing bulk solvation effects. The study focuses on both affinity and selectivity. General trends in binding affinity to selected ions are discussed as related to the electronic structure of the compounds. Chelator selectivity toward In(III) and Ge(IV) is investigated in comparison to Fe(III), Fe(II), Cu(II) and Zn(II). The importance of both properties arises from expected high concentrations of these interfering ions relative to the strategic elements of interest. Financial support from the Krüger Research School “Biolohydrometallurgical Center for Strategic Elements” BHZM (Nr. 0210205) is gratefully acknowledged.

WEPC19 Cellulose Nanofibers as building blocks for innovative materials for remediation A. Fioratti, INSTM local unit / Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta and INSTM Local Unit; A. Graziano, L. Melone, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grassi, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Pastori, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; C. Punta, Politecnico di Milano

From the point of view of circular economy cellulose is one of the most interesting biopolymer since it derives from renewable sources which, thanks to its peculiar structural properties, it is widely used in the design of simple and advanced materials for different applications. Recently, cellulose nanofibers (CNF) were proven to be versatile building blocks for many preparations. The regioselective oxidation of the C6 primary hydroxyls of the anhydroglucose units, catalysed by TEMPO in the presence of the NaBr/NaClO oxidant system, leads to the formation of TEMPO-oxidized CNF (TOCNF), conferring to the cellulose many interesting properties.2,3 We recently report the synthesis of sponge-like nanostructured materials by cross-linking TOCNF and branched polyethyleneimine (bPEI).3 These materials were fully characterized from a chemical, structural and mechanical point of view. Quantitative information on their inner microstructure were collected by Micro-Computed Tomography (μ-CT) analysis.4 In addition the material can be easily modified in order to introduce additional chemical or structural properties. As an example, by functionalizing the bPEI with pN203-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective sensing of fluoride anions.4 Furthermore, the addition of citric acid (CA) as co-crosslinker enforce the mechanical and structural performances.6 Another application of bPEI-TOCNF sponges is the controlled release of active principles. They have been used it for adsorption and release of two model drugs, amoxicillin and ibuprofen. The material showed very good performances in adsorbing both model drugs (~200 mg/g) from methanol solution. Interestingly, the presence of CA A led to slower kinetic release in aqueous environments if compared with materials obtained without CA.4 The ongoing NanoBonD project is focused on the use of these sponge-like materials for soil and water remediation. We have demonstrated that these materials exhibit superb performances in removing contaminants both from fresh and from sea water. In particular we are able to remove heavy metals (Zn2+, Cd2+, Pb2+, Cr3+ and Cu2+) and organic contaminants (e.g. pyriproxyfen and 2,4-D). We are exploring the material behavior in an ecotoxicological point of view by testing their performances towards exposure to marine and freshwater species such as algae and bivalves, hence the definition of eco-friendly materials.

WEPC20 Zn-Al layered double hydroxides: a promising eco-friendly engineered nanomaterial R. Martins, Department of Biology, University of Aveiro / Department of Biology and CESAM; J. Figueiredo, University of Aveiro / Biochemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Tedim, University of Aveiro / Department of Materials and Ceramic Engineering CICECO; S. Loureiro, Universidade de Aveiro / Biology

Layered double hydroxides (LDH), also known as anionic nanoclay, are a class of inorganic engineered nanomaterials with a plate-like structure featuring a lateral size of 20–40 nm. LDH are characterized by positively charged metal hydroxides (e.g. Zn2+, Al3+) stabilized by anions (e.g. NO3-) and water molecules between layers. LDH have remarkan properties as non-chemical and non-toxic nature, intercalation and exchange capacity, controlled release capacity, high specific surface area and stability. The safe-by-design structure and composition as well as the properties of Zn-Al LDH have led their use in several industrial and material engineering greener applications, as well as in medicine and pharmaceutics for a safe controlled release of drugs. Despite LDH have been regarded as having low toxicity, there has been some controversy regarding the effects on obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (till 100 mg/L), but significant biochemical effects, even at low exposure concentrations. The present study aimed to assess the hazard of Zn-Al LDH in several marine species representing different trophic levels. Exposure tests were carried out with 15 species, including bacterium (Vibrio fischeri), cyanobacterium (Arthrospira maxima), microalgae (Isochrysis galbana), Nanochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chui and Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Hexide dilisivior), crustaceans (Acartia tonsa, Artemia salina and Palaemon varians) and sea urchin embryos (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adaptions in some cases. Exposure concentrations ranged between 0.01 and 100 mg/L depending on the species tested. The nanomaterial exhibited no toxic effects in most of the tested species, even at the highest exposure concentration. However, adverse sub-lethal effects, such as changes in the enzymatic activity or the physiological endpoints were noted in bivalve and crustacean species. The predicted no-effect concentration (PNEC) of Zn-Al LDH for seawater was set at 0.2 µg/L, based on the lowest NOEC available (Martins et al. 2017). The results suggest that Zn-Al LDH is a promising engineered nanomaterial featuring a very low environmental hazard.

WEPC21 Studying microfibre release from textiles towards improved clothing design R. Johansson, Helly Hansen; S. Kubowicz, SINTEF Materials and Chemistry; I. Yousef, S.W. Haugen, Helly Hansen; A. Booth, SINTEF Ocean / Environmental Technology

Clothing manufactured from synthetic fabrics such as polyester and nylon can release hundreds of microfibres to waste water systems when washed in domestic washing machines. Fleece fabrics have been of particular focus, however, fleece clothing can be made from a wide variety of different fabric constructions, which may exhibit different microfibre release characteristics. Mechanical and chemical finishing of the yarn and fabric will influence the size and
volume of the microfibres released. In the current study, we assess the release of microfibres from different fleece fabrics with the aim of identifying production methods and fabric properties that release the fewest microfibres during domestic washing machines. A filter unit consisting of a 300 µm filter and a 100 µm filter in series was connected to the effluent pipe of a domestic washing machine. Each fleece test fabric (140 cm x 90 cm) was prepared by placing it on a wooden frame and washing it (one detergent cycle) on a standard synthetic clothing program (40°C for 1 hr. 40°C). Weights inside the washing machine assured the same mass for each material assessed and a consistent water flow into the machine. Effluent water was collected in a clean container and a sub-sample (1 L) passed through a 20 µm filter to collect any microfibres that pass through the filter unit. Each test fabric was first washed to study release in new clothes, and then washed a second time to determine release related to repeated washing. To improve the accuracy of the results, the two washing procedures were repeated in triplicate. A rinse cycle was run between each test wash to ensure removal of any remaining microfibres from the system. The hoses connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-filtered weights were allowed to dry before the mass of fibres was determined. The number of fibres was then estimated based on microscopy counting of a pre-weighed sub-sample of the microfibres. Preliminary results show that ~80–90% of fibres in the effluent water are trapped by the 300 µm filter. Furthermore, the fibre release declines with successive washings. A detailed study of the underlying mechanisms is currently ongoing and the results will be used as a basis for ranking.

WEC23
Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)
F. Schwab, Adolphe Merkle Institute / Materials Science; M. Maceroni, Adolphe Merkle Institute / BioNanomaterials; A. Petri-Fink, B. Rothen-Rutishauser, Adolphe Merkle Institute / BioNanomaterials Group
Nano-agrochemicals promise higher efficiency than conventional pesticides, but much has to be learned about the gain of efficiency compared to conventional products, and the risk of directly applying such new types of yield enhancers on agricultural soil. Due to the relatively low acute toxicity and high natural abundance of silica nanoparticles (SiO₂-NPs), they are highly attractive for benign-by-design strategies in agriculture. Here, we present initial results of experiments that are in the process of being conducted on a laboratory scale to compare the effects of SiO₂-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO₂-NPs used for the experiments were ~60 nm in primary particle diameter. As reference substance for conventional pesticides, the broad-spectrum fungicide tebuconazole was tested. Seed germination and infection tests, and a plant growth test were conducted. The Si was quantified by inductively coupled plasma – optical emission spectroscopy (ICP-OES). Beneficial effects of SiO₂-NPs were found for the fungal infection and germination rates in alfalfa, while the growth rates in the seedlings transferred to and grown in soil remained largely unaffected. The results confirm the moderate protective effects of silica nanoparticles on plants that have been reported previously, likely linked to the release of orthosilicic acid (Si(OH)₄) acting as a phytostimulative micromineral. The use of silica in nanoagrochemicals promises to reduce the organic pesticide burden of agricultural soil and crops. Acknowledgement - The authors thank the Swiss National Science Foundation (http://psf.nsf.ch/Project-168187) and the Adolphe Merkle Foundation for the support and funding of the study. We thank Laura Rodriguez-Vanhecke, and Sandor Balog for helpful discussions regarding ICP-OES analytics, electron microscopy, and dynamic light scattering, respectively.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (PC)

WEC24
Environmental Footprint for pasta production - the PEF pasta pilot
L. Ruini, Barilla G.e.r. Fratelli Societa per Azioni; L. Laurenza, UN.A.F.P.A.; L. Marchelli, Barilla G. & R. Fratelli; P. Borla, Life Cycle Engineering UN.A.F.P.A., representing all the European pasta manufacturers, is the main driver of the EU pilot on PEF for pasta production. Furthermore, some Italian companies of pasta producers (Barilla, Pasta Zara and Garofalo) decided to be directly part of the Technical Secretariat. The proponents of the pilot for pasta together represent about the 30% of the total production of pasta in the European Union. The PEF pilot, while encouraging the development of sustainable production all over the supply chain from farm to fork, enhances fair competition across the pasta market. The aim of this instrument is to set up a PEF framework for pasta production. In line with the PEF approach, the project also promotes the development of process group-specific rules (PEFCR), including the development of performance benchmarks; Testing different compliance and verification systems, to set up and validate proportionate, effective and efficient compliance and verification systems; Testing different business-to-business and business-to-consumer PEFCR information systems in collaboration with stakeholders. The secretariat sees the PEF pilot as a big opportunity for the pasta sector since there are some pasta producers that already measure and communicate the environmental impacts through voluntary certification schemes. A methodology promoted by the European Commission can encourage other producers to communicate the environmental footprint of their pasta, making PEF a tool able to increase competitiveness with important benefits for sustainable agriculture and food production. This approach would be good also for consumers. Giving people reliable and comparable information about the environmental impacts and creating the awareness and organizational potential to improve the most resource efficient and environmentally-friendly products. During the PEF pilot, an average impact value, representative of the category of dried pasta has been obtained to allow the environmental performance comparison among different products in the same category. This benchmark impact highlighted the process hotspots as cereals cultivation, pasta production and cooking phase. All adopted rules and hypotheses in the PEFCR document have been established throughout the maximum clarity in order to increase the suitability and robustness of the LCA implemented in the PEF method for pasta sector. The main difficulties noticed during the pasta pilot were about the hotspots management, when the producers do not directly manage those processes.

WEC25
Life Cycle Assessment of applying Algal Oil in salmon aquaculture; challenges for methodology and tool development
H. Bosch, DSM Nutritional Products; A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH; F. Ziegler, RISE Research Institutes of Sweden
Evonik DSM formed the joint venture Veramaris®, introducing a new Algal Oil based omega-3 fatty acid source for aquaculture. This intracellular oil is produced in a biotechnological manufacturing process using non-marine resources. The rationale for this development is that the capacity to generate omega-3 fatty acids through fish is not sufficient to fulfill the dietary requirements of a growing population, and that many fish species used as feed in aquaculture are either fully utilized or overfished, leaving little room for expansion. Algal Oil reduces the dependency of salmon aquaculture on marine fatty acid production and fish stocks, by replacing marine ingredients with algal oil and crop-based ingredients. To illustrate the environmental impacts and potential tradeoffs of this new product, a Life Cycle Assessment (LCA) was performed. Indicators developed for application of LCA to fisheries were used in an LCA to assess the marine ecosystem impact of replacing fish meal and fish oil by Algal Oil in salmon feed. The analysis had to be performed in a separate calculation outside the LCA software, because the software does not include the required data and methods. The study demonstrated that the use of Algal Oil as a source of omega-3 fatty acids leads to a considerable reduction of impact on marine ecosystems of farmed salmon. This improvement is accompanied by an increase in impacts associated with agriculture. Current LCA methodologies do not allow weighting of these opposing effects. However, to make informed choices between the available options this would be required. Because the availability of natural marine resources is limited, the strong growth expected in salmon aquaculture requires innovative feed solutions decoupled from limited fish stocks to meet future requirements for omega-3 fatty acids. Veramaris® Algal Oil in combination with vegetable crops enables growth of salmon aquaculture that is independent of limited fish stocks. To support the choices discussed in this presentation, and similar choices, implementation of fishery impact assessment methods in LCA tools and development of weighting methodology is essential. Just as for other biotic impacts, there are also challenges of non-linearity and temporal and spatial variability connected to fishery-specific impacts, which are of a more local nature than global-scale life cycle impacts.

WEC26
Balancing Environmental and Health Impacts of Food Production and Consumption
C. Walker, Institute of Environmental Engineering, ETH Zurich; S. Hellweg, ETH Zurich / Institute of Environmental Engineering
An individual’s food choices can affect not only the magnitude of their food related environmental footprint, but can also have a direct effect on their personal health.

People consuming lower amounts of meat tend to have lower environmental impacts, but it has also been found that they also tend to have lower risk of certain diseases. On the other hand, people with low vegetable or fruit consumption may also have relatively lower environmental impacts, while having increased risk of disease. This study investigates the daily eating patterns of a European population sample to identify and compare each individual’s environmental impacts due to their food production as well as the health impacts that can be expected due to their food consumption patterns. The Global Burden of Disease has identified dietary risk as a leading risk factor, that have been estimated to contribute to increase of disease. Algal Oil risks such as low fruit, vegetable, nut and seed, or omega-3 intake and high red meat or processed meat intake. The relationship between the environmental impacts from producing foods classified in the dietary risk factor categories are compared to the health impacts associated with consuming these foods. From this investigation, we can estimate the magnitude of the health benefits associated with additional food production, as is shown in an example of whole grain consumption. Results show that for individuals under-consuming whole grains (less than 125 grams daily), for every 1 micro disability adjusted life year (µDALY) increase in production impacts, there is a health benefit of 141 µDALYs. Similar results were found for all
dietary risk categories in which under-consumption of a particular food group was considered a dietary risk. In cases where overconsumption poses a health risk, as is the case in certain meats, sodium, and sugar sweetened beverages, a 1 µDALY increase in production impacts is associated with increases in health impacts to varying degrees, ranging from 1.2 µDALYs for red meat up to 36.8 µDALYs for sugar sweetened beverages. This study found that for most of the dietary risk categories, health impacts due to consumption far outweighed the environmental impacts (measured in terms of µDALYs), however this study did not include environmental impacts as they are related to other impact categories such as ecosystem damage and resource depletion, which must also be considered to fully capture food production impacts.

WEPC27
What not to waste? Improving decision support for Food Loss and Waste (FLW) mitigation by considering food security and environmental sustainability
F. Sessa, Quantis; M. Ruth, World Business Council for Sustainably Development (WBCSD); D. Pollard, Nestlé; K. Cooper, A. Cairns, World Business Council for Sustainably Development (WBCSD); X. Bengoa, S. Humbert, M. Vargas Gonzalez, A. Ernstoff, Quantis
LCA-based methods provide evidence of the largescale environmental impacts of food production. Nearly a third of food produced is lost or wasted, meaning production impacts occur with little to no societal service. The primary focus of response e.g. the UN SDG 12.3 has been on avoiding food loss and waste (FLW) quantity, for example halving food waste by 2030. Decision-makers, thus may prioritize FLW mitigation based on quantity, economical gain, and ease of implementation. To support multi-criteria sustainability decision-making we develop a framework and perform a global screening to prioritise FLW mitigation efforts based on two material issues: environmental impacts and nutrition security. LCA-based methods quantify environmental impacts related to FLW streams, and nutrition and global burden of disease data are used to quantify nutrition security. A global screening of FAO data on food production, supply, and FLW for various food categories (e.g. grains) is performed in 15 countries. Results demonstrate vasty different environmental impacts and nutrition security potential associated with various FLW streams. The results suggest that there is sufficient production of most nutrients globally, suggesting that in most cases food systems do not need to grow, but need to be optimized to reduce FLW and offer appropriate regional supply.

WEPC28
ARIADNA Project. Analysing the sustainability of implementing a mandatory Deposit-Refund System in Spain
A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fulliana, B. Díaz, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Colomé, Universitat Pompeu Fabra UPF / Escola Superior de Comerç Internacional; J. Ribas, Universitat Pompeu Fabra UPF; S. Ayuso, Universitat Pompeu Fabra UPF / MANGO Chair in Corporate Social Responsibility; I. Muñoz, 2.0 LCA consultants; B.P. Weidema, Aalborg University / Department of Planning
There is currently an ongoing debate in some Spanish regions on whether the implementation of a mandatory deposit-refund system (DRS hereafter) would be appropriate. A DRS can be simply defined as a system in which consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. This is a system in place in some European Countries such as Germany, Finland or Denmark whereas others such as France or the UK have refused its implementation. From a regulatory point of view, the Spanish Law 22/2011 (which transposes the correspondent European Directive 2008/98/CE), clearly states that the implementation of a DRS should be based on the analysis of its technical and economic feasibility, a set of environmental, social and human health impacts and must ensure the proper functioning of the internal market. The study presented here follows this regulatory framework, analysing the sustainability of implementing this new system, combining environmental, economic and social studies in order to get an holistic picture of its feasibility. In particular, the following methodologies were used: (1) Life Cycle Assessment (LCA) for the environmental study; (2) Classic Cost Accounting for the economic study and (3) Social Footprint and Quantification of the Integrated Social Value for the social study. All of them applied using the same data, system boundaries and modelling restrictions. The study clearly concludes that the introduction of a DRS in Spain, under the studied conditions, is not advisable. This is because: a) according to several environmental indicators, although it could achieve an improvement in the overall recycling rate, it carries a higher environmental impact, mainly due to the duplication of collecting systems and the increase demand in transportation; b) represents a 4.6-fold increase in the economic cost to society (11 times if we only consider the management of DRS containers); and c) from a stakeholders’ point of view, it will have a significant increase both in space and time needs, and it will cause a higher Social Footprint.
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**Note:** The above table represents a portion of the abstracts from SETAC Europe 28th Annual Meeting Abstract Book.
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