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

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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.

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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?
Roger Strand, 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
Berghard Urf, 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
Eugenia 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” technologies such as whole genome sequencing, epigenetic profiling, transcriptomics, proteomics and metabolomics have provided a snapshot of 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 for antibiotics, as required by the European Medicines Agency guidelines 2006, adopts the use of one species of cyanobacteria 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 bacterial 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.

1  SETAC Europe 28th Annual Meeting Abstract Book
Modelling and monitoring of pesticides fate and exposure in a regulatory context (I)

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

N. Mackay, FMC Corporation / Environmental Modelling; A. Alish, Dow AgroSciences / Risk Management; G. Azimonti, ICPs; A. Chapple, Bayer Crop Science AG; P. Miller, Silsoe Spray Applications Unit Ltd; K.M. Niemistö, European Commission - DG SANCO / PPR; C. Pickl, Federal Environmental Agency; T. Wolf, Agrarix Ltd. 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 enhance 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. Because of 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 evaluation of two models that have been used within a regulatory context in the EU: IDEFICS and the SSU 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. Crosweller, BASF SE; Z. Gauho, 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. Zillgvens, 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 organisations 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 radio-labelled chemicals with various properties by potato, tomato or wheat plants 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 leaching 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 value of 1 (calculated from the uptake coefficient of Briggs et al., 1982) and the 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 Regulatory Groundwater Monitoring of Crop Protection Products and their Metabolites in Europe

R.L. Jonge, 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, BRCM; A. Bongers, BASF SE; F. Fernández, CREA; S. Gao, Bayer CropScience AG / Environmental Safety; 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. Lotseaux, Syngenta; A. Massey, Health and Safety Executive / Environmental Fate; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; L. Monozierski, SCE; A. Newcombe, ARCADIS US Inc; L. Padovani, European Food Safety Authority (EFSA); A. Poot, Cogb, GLL, Reeves, Dow AgroSciences Ltd; S. Reichenberger, DR. KNOELL CONSULT GmbH; A.E. Rosenbaum, Geological Survey of Denmark and Greenland / Geochemical; H. Staudnemair, BASF SE / Crop Protection, Environmental Fate; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; A. Schwen, AGES; M. Stemmner, 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 provided to date in 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 aquifers. Examples of proposed site and recommendations 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. All models used in the EU environmental leaching assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with a 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 tens of 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. Explorations 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. Simulations showed that for the SFO leaching system the finite penetration depth decreased 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
of the simulation period.

5 Bespoke monitoring to support Tier 4 FOCUS groundwater assessment

S.L. McMains, Syngenta; S. Payvandi, Syngenta Ltd; P. Sweeney, Syngenta; L. Fish, Syngenta Crop Protection, LLC / Environmental Safety; R.J. Andrews, D. Schofield, Ramboll Environ; J. White, ARCADIS UK; N. Jones, Syngenta Ltd; G. Langridge, CEM Analytical Services Limited; T. Oteyza, Syngenta Crop Protection AG; M. Greener, Syngenta Ltd

Data generated from this bespoke groundwater monitoring programme will offer a solution to address the non-relevance case of pinoxadze metabolites from an exposure site. Median modelled mass flux was determined using GeoPEARL 3.3.3 simulations over 20 years which represent vulnerability to leaching across the EU27 under standard conditions. These data were aggregated to a 10km² level and combined with a shallow groundwater dataset and a cereal land use dataset based on wheat in CAPRI. Those grid cells in the upper 50th percentile for each spatial layer (mass flux, shallow groundwater, and wheat) were considered for the site selection process. Sites identified by modelling were assessed during site walkover surveys. To justify inclusion in the programme, sites had to have a history of pinoxadze use, groundwater less than 10m bgl, no confining layers, and no significant features which may act as preferential flow pathways. In 2015, 70 sites were installed across France, Germany, Italy, Lithuania and the United Kingdom. Each site consisted of three shallow wells installed around the field perimeter. The 70 sites represent all EU FOCUS groundwater scenarios except Jokioinen. The sites have all had a minimum of two pinoxadze applications before 2016 with groundwater levels an average of 2.9m below ground level. Sampling began in 2015 from 84 down magnetic gradient wells. Of the 871 samples collected between June 2015 and July 2017 from these 70 vulnerable sites, the average for each site never exceeded 0.1μg/L. Only minor residues of metabolites have been detected since sampling began. Monitoring is to continue until Q4 2019 to ensure a thorough assessment of groundwater vulnerability is made. The modelling approach should allow extrapolation of the modelled vulnerability to be extended to member states outside of where the wells were installed.

6 Long-Term Trend of Aquatic Pesticide Risk

A. Paulus, UFZ - Helmholtz Centre for Environmental Research / System-Ecotoxicology; S. Kuilmann, K. Foit, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Liess, UFZ Centre for Environmental Research / System-Ecotoxicology

European Union member states aim at reducing ecological risks exerted by pesticides. For this, reliable trend indicators of pesticide exposure and risk are inevitable. Based on this demand we designed a long-term trend indicator of aquatic pesticide risk for Germany. It uses pesticide sales statistics, toxicity data and chemical properties as input variables. The trend indicator was designed by combining the most reliable exposure and effect models. (i) We selected the most existing exposure model by evaluating several established exposure models. For this we tested their performance with peak concentration data monitored in small agricultural streams in central Germany. These field data comprised of event-driven samples of 46 active substances from field-campaigns performed in 1998, 1999, 2000, and 2013. The highest agreement of measured and modelled peak concentration was yielded by the risk indicator EXPOSIT/EVA (R²: 0.38), followed by the more complex model TREND (R²: 0.36), SYNOPS-TREND (R²: 0.24), and GERDA (R²: 0.24). (ii) The translation from toxic pressure to pesticide risk was implemented by applying the field based and validated exposure – response relationship SPEAR_relate. Based on these information and models, we calculated the trend of toxic pressure and pesticide risk in Germany from 1996 to 2016 for the 500 substances authorized in this period. The method presented here requires only few input data, is based on validated models and can be adapted to regional conditions around the world.

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

7 The hydrophobicity delay: symptoms and solutions

A. Celsie, Queens University; D. Mackay, Trent University / Chemistry; D. Powell, DMER Ltd.; J. Parnis, Trent University / Cemistry

The objective of this presentation is to set out the conditions under which chemicals of high hydrophobicity experience significant delays in approaching equilibration conditions. We suggest that this delay may be misinterpreted as being caused by a change in partitioning behaviour or mechanism resulting in development of non-linear regression models describing inter-media partitioning. In reality, the partitioning is fundamentally linear but is distorted by a kinetic delay. The rate constant format commonly applied to fish biotopuase from water of concentration C is 

\[ \frac{dC}{dt} = \frac{k_1}{k_2} \cdot \text{mass flux} \cdot C \times \text{fish mass} \]

The characteristic time for uptake and loss is \( \tau = \frac{L}{k} \). Slower uptake and loss will occur if the partition ratio \( K_a \) is large, and the fish must contact \( K_a \) times its own volume to approach equilibrium. Very hydrophobic substances will experience long time delays when approaching equilibrium and correspondingly long times for loss during a depletion phase. Mackay et al. [1] modeled bioconcentration and toxicity of superhydrophobic chemicals D4, D5, and D6 using a biotopuase model for fish. Due to the very high hydrophobicity (log \( K_{OC} = 10^4 \)) for D5 and very low water solubilities \( C_{W} \) must be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated to be \( \approx 2000 \text{ days} \), to get \( C = 2 \cdot \text{mol/L} \) about 17 days. The study concluded that for superhydrophobic substances organisms will likely not reach toxic concentrations within the test duration which is usually 4-94h. Doucette et al. [3] reviewed foliage/partitioning data in which the onset of a hydrophobic delay (HD) is appropriate when log \( K_{OC} = 7 \) developed a model for uptake of hydrophobic chemicals by foliage. This model shows levelling off corresponding to insufficient time to achieve equilibrium. A kinetically limited regime is reached at a \( K_{OC} = 10^4 \). In our presentation we will address the HD issue that we believe is a widespread phenomenon applicable to numerous environmental systems including passive sampling and partitioning to aerosol particles. Finally, we suggest a general method for identifying the HD problem. [1] Envir Sci Technol 2015, 49(19): 11913-22. [2] Environ Toxicol Chem 2012, 31(8):1911-9. [3] Environ Toxicol Chem. 2017. Accepted. [4] Environ Sci Technol 1999 33:1799-1804.

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

M. Castro, Stockholm University / ACES; M. Breitholtz, B. Yuan, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); I. Athanassiadis, Stockholm University; L. Asplund, A. Sobek, Stockholm University / ACES

Chlorinated paraffins (CPS) belong to a group of industrial chemicals consisting of n-alkanes (from 10 to 30 carbon chain atoms) with chlorine content from 30 to 70% weight. They are widely used as high-pressure lubricants, flame retardants, and additives in plastic, rubber, and sealants, leading to high-production volumes worldwide. These chemicals are also ubiquitously found in the environment. The use of short chain chlorinated paraffins (SCCPs) in Europe has been restricted, however, medium (MCCPs) and long chain (LCCPs) chlorinated paraffins are used in Europe as substitutes for SCCPs. In some countries, all classes are still in use, leading to high production volumes (over a million tons per year globally). There is a lack of data on CP physicochemical and hazard-based properties, which is due to their inherent high complexity. CPs are hydrophobic contaminants, which complicates their aquatic toxicity testing. In this work, we validate the use of partitioning dosing for the study of bioaccumulation and parallel the research on the partitioning behavior of CP technical mixtures between silicone, water and organic carbon. We used 5 different technical mixtures from the three established categories (2 SCCPs, 1 MCCP, 1 LCCP). We added Daphnia magna to the passive dosing system, to understand the partitioning behavior of CP technical mixtures from CP-dosed water medium to CP-free organic matter (KOCwater). Immobilization of D. magna was observed after 48 hours under different exposure concentrations. APCLI-QTOF-MS was used for CP quantification. Both silicone-water and organic carbon-water partition coefficient overlap between different categories of CP technical mixtures. CP-52, labelled as a MCCCP, had a similar silicone-water partitioning coefficient as a restricted SCCCP – Huelts 70C. We demonstrate that increasing average chlorine content of each CP mixture significantly increases the Log KOCwater and Log KOCwater. These results could have implications on the study of environmental fate of CPs: in-use CPs (MCCPs and LCCPs) might be equally or more bioaccumulative as restricted SCCCPs. KOCwater is particularly helpful at predicting bioaccumulation of chemicals into biota. The next step is to quantify the bioaccumulation potential of CPs. With the use of the passive dosing approach, we are producing laboratory experimental data that can be used to help in the on-going regulatory discussion on MCCPs and aid their risk assessment.

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


The trophic transfer of cyclic methylsiloxane (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk. These compounds specifically octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5), and dodecamethylcyclohexasiloxane (D6) was determined for the Lake Pepin, Minnesota (USA) 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',4,4',5,5'-heptachlorobiphenyl (PCB-180), in Lake Pepin. TMFs for the three cVMS materials and PCB-180 were determined using standard
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 observed in the highest trophic levels. TFMs measured for the three cVMS elements were all99.5% of the uncertainty for cVMS TFMs 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. TFMs for the cVMS chemicals and PCB-180 were determined using a Monte-Carlo probability analysis technique, and the likelihood of the values exceeding 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 Polycyclic Hydrocarbons 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 Estuary Institute; K. Xu, Louisiana State University / Department of Oceanography and Coastal Sciences
The present study reports the discovery of a suite of polycyclic hydrocarbons (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 Dianshan (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, 3,6,6,8-tetrabromo, 1,3,6,8-tetrabromo, 1-bromo-3,6-dichloro-1,8-dibromo-3,6-dichloro-carbazole 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 potencies (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
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Essential oils are fragrance materials that are registered as natural complex substances (NCS) under the European REACH legislation. One of the categories of information required in a REACH registration is information about the potential for bioaccumulation of NCS by fish. Determining the bioaccumulation factor (BCF) of essential oils can be complicated, as a standard flow-through uptake/depletion experiment. Previously, we demonstrated that a single dietary exposure coupled to the benchmarking technique could be applied to an artificial mixture for measuring the in vivo BCF. Here, we report an application of our proposed BCF-determination methodology on a real essential oil – pine oil. Fish (rainbow trout) were dosed with a mixture of the pine oil and a suite of benchmark chemicals via a single bolus exposure. The bioaccumulation factor (kBCF) in the fish soma (without GIT) for the key pine oil constituents are 0.134 d1
3 (β-Caryophyllene, BCP) – 1.41 d1
4 (BAC) and they were 0.00799 d1
4 (HCB) – 0.517 d1
4 (DCB) for the reference chemicals. The test compounds depurated faster from the soma than the GIT, making estimated whole-body depuration slower (conservative) compared to the soma only. HCB was the chemical most resistant to depuration among all the test compounds. Benchmarking to HCB reduced the standard error of measured kBCF for the soma from the soma for most of the chemicals, with kBCF ranging from 0.001 d1
4 (PCB252) to 2.98 d1
4 (BAC). The apparent BCF (BCF), values in soma for the key components in pine oil and the reference chemicals were in the range of 98.2 L kg
-1 (BAC) – 1030 L kg
-1 (BCP) – and 267 L kg
-1 (D12C) – 1730 L kg
-1 (HCB), respectively; while for the benchmarked BCF (BCFas) in soma, they are 46.3 L kg
-1 (BAC) – 2570 L kg
-1 (BCP), and 208 L kg
-1 (D12C) – 197000 L kg
-1 (PCB52) respectively. We conclude that a single dietary exposure coupled with the benchmarking technique is a feasible experimental approach for measuring the BCF of NCS in fish.

12 ROLE OF ADIPOSE TISSUE RESPONSIBLE FOR ECHOLOCATION IN THE BIOACCUMULATION PROCESS OF LIPOPHILIC COMPOUNDS IN HARBOUR PORPOISES
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Previous studies have suggested that persistent organic pollutants (POP) can lead to adverse effects in marine mammals, including harbour porpoises (Phocoena phocoena), thereby causing illnesses. Traditionally, blubber is an ideal matrix to assess POP bioaccumulation in marine mammals. However, during times of energy deficits, blubber tissue is broken down in which POPs are redistributed in the body. Echolocating tissues melon and mandibular fat are inert lipid bodies in odontocotes and, in contrast with blubber, are less prone to release POPs, which makes them ultimate sinks for POP lifetime bioaccumulation. This study aimed to assess the lifetime bioaccumulation of POPs in harbour porpoises through 1) analysis of POPs in various tissues and/or organs of harbour porpoises, including lipid rich bodies as blubber, melon and mandibular fat, and 2) Physiologically based toxico-kinetic (PBTK) modelling of PCB 153 and PBDE 153 to compare bioaccumulation of lipophilic compounds in lip-rich tissues with different lipid composition and purpose (echolocation versus insulation) over the whole lifespan of male harbour porpoises. Overall, POP analysis and PCB 153 modelling for male harbour porpoises reveal that despite differences in lipid composition and lipid types, lipophilic pollutants bioaccumulation patterns are similar in blubber, mandibular fat and melon with increasing age. Nevertheless, the model showed the highest levels of PCB 153 in mandibular fat, followed by melon and blubber. From these results, mandibular fat can be considered as a sink for PCB 153 and a better proxy for lifetime exposure than blubber, which can be both a sink and source of lipophilic pollutants. PBDE 153 PBTK modelling reveals that bioaccumulation differs in lipid composition and lipid type, whereby bioaccumulation predominantly occurs in echolocating tissue during juvenile stage and in blubber during adulthood.

Keywords: Echolocation, lifetime bioaccumulation, biomonitoring, PBTK modelling, POP

Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information

13 LCA: everything is relative and nothing is certain
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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 criticism is that these proposals do not account yet for ‘correlations’. We distinguish between two meanings of the term ‘correlation: 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 (uncorrelated). Independent sampling in this case means that the data are uncorrelated. Correlated sampling implies that data are shared across processes between the product alternatives compared, 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 output process 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 different data sets in LCAs and illustrate its use in LCAs.
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

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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 CI’s 95% CI was primarily attributable to fragrances (61%), surfactants (20%), and the amount of product 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

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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 LCA results are hindered by the fact that 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 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 condition considered. This methodical step was necessary for carrying out discernibility analyses across background conditions, allowed 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.

16 Which impact categories are relevant for LCA results interpretation?

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LCA is intrinsically a multicriteria approach comparing (almost) all the potential environmental impacts of human activities. However, multicriteria decision problems characterised as a wide range of environmental impacts results may lead to unclear conclusions. Based on their relevance, a choice among the impact categories 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 Esnouf 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 derived. The R+ is a proximity measurement between standardized 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 variability. Life Cycle Inventory (LCI) regionalization deals with increasing 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 the spatial variability of the receiving environment. Regionalized characterization factors (CF) apply to the regionalization 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 sectoral recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. These recommendations mean that 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 can be said 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.

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

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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 increasing 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 the spatial variability of the receiving environment. Regionalized characterization factors (CF) apply to the regionalization 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 sectoral recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. These recommendations mean that 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 can be said 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: MO387, MO388, MO389

5 SETAC Europe 28th Annual Meeting Abstract Book
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

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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

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The Holtemme River 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 wastewater 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 other chemometric sets to tentatively identify more than 3500 compounds. A number of these 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, carbamazepine, etc.), personal care products (UV stabilizers) and food additives (e.g., succinate), some of them (e.g., sulfuric) 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

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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 sucralose. 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 were found to be 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

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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 S-transferases (GST) which are present in the human liver at high concentration. 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 more than one place they are actively 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 bio degradation 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-form from the parent compound. Finally, a targeted method was developed for the identification of these compounds in wastewater and surface water. This work was possible due to support from EU-FP7 programme (Solutions project), Merck (LC columns) and Biotage (SPE cartridges).

23 HR-MS non-target analysis for transformation products of emerging organic contaminants in wastewater fractions pre-screened by ELISA


High-Resolution Mass Spectrometry has its benefits but still wastewater samples challenge the analyst on the quest for “unknowns”, metabolites and transformation products of emerging organic contaminants (EOCs). Their detection requires non-target analysis which involves not only costly instrumentation but also scientists with the time to plough through the enormous amount of data collected. An approach is presented using antibodies as selectors to pre-screen fractions of an
HPLC run for “binding” in order to detect hitherto unknown but structurally related compounds. Carbamazepine (CBZ), an anti-convulsant and anti-depressant, sulamethoxazole (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 considerable reactivity to CBZ:10,11-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 reconstituted with 15 µl of 0.1% TOP-ESI-MS aqueous 0.1 % formic acid. Fractions applied on a specifically “positive” fraction revealed an exact mass of m/z = 389.168 and a chloride pattern. The compound is cetrizine, an antihistimine. 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 ELISAgarm. Careful analysis of the fractions led to the identification of N4-acetyl sulamethoxazole, 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


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 chemicals. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and biocatalytic methods. The EU DWD states 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 provide an overview on the establishment of a risk-based monitoring program for all 13 supply zones involved, mostly consisting of groundwater. We use both target and non-target/suspect monitoring data and well characteristics. We use clustering techniques combined with prioritization techniques including substance properties and in vitro as well as in vivo 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)

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

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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 bioconcentration 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 bioconcentration factors (BCF) in fish. Where possible, fish BCF values were regressed 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

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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 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. [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 390/1

27 Ecotoxicological assessment of Caretta caretta (Linnaeus, 1758) in the Mediterranean Sea using an integrated non-invasive-approach

S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente; I. Caliani, M. Giannetti, L. Marsili, S. Maltese, D. Coppola, N. Bianchi, T. Campani, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment Caretta caretta is the most common sea turtle in the Mediterranean Sea. The IUCN assessment for this carnivorous long-lived reptile underlines the lack of information regarding pollution and pathogens and indicates as a priority efforts to investigate and reduce the impacts of these threats. Up to now very few studies were conducted investigating biological end point potential contamination caused by human activities in the Mediterranean Sea. The aim of our study was to conduct the first ecotoxicological assessment of this species in the Mediterranean sea using a non-invasive integrated methodology. We set up and applied a monitoring protocol which also includes endpoints, such as CYP1A, Lipid peroxidation, ENA assay, B esterases, never investigated before in this species. Seventy-five loggerhead turtles were sampled in a participative way in Italy and Greece. The Rescue Team for Mediterranean sea Caretta caretta was retrieved from the free-ranging along the Spanish coasts. Blood, skin and carapace samples were used to test biomarker responses and contaminant (OCs, PAHs, Pb, Cd, Hg) levels. We measured biomarkers of exposure to lipophilic contaminants (CYP1A in skin biopsies), biomarkers of indirect and direct effects investigating neurotoxic (estersases inhibition) and estrogenic (vitellogenin) effects, oxidative stress (lipid peroxidation), genotoxicity (Comet and ENA assays) and liver damage (Gamma Glutamyl Transferase). Elaboration of experimental results was carried out taking also into consideration different age classes of the specimens. Among the main results obtained we should underline the statistically significant correlation between
28 Sucking claws or hunting seals - consequences for walrus health
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The walrus (Odobenus rosmarus) is a large, ice-associated marine mammal with distinct feeding habits. Concentrations of the main chlorinated pollutants, namely polychlorinated biphenyls (PCBs) and chlordane, 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 with different 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 lipopolicholic 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 blubber were positively correlated with measured concentrations of HCH isomers, 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 polychlorinated compounds in blubber, but not to PFASs. In conclusion, this study indicates that walruses are exposed to a wide range of contaminants including PFASs, toxins, and pathogens, and that these contaminant exposure may contribute to the observed health problems in this species.

29 Triclosan-induced embryotoxicity in the yellow-legged gull
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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, the impact of the low level of 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 information on TCS is lacking. The aim of this study was to explore through in ovo injection, the potential embryotoxicity of TCS in the yellow-legged gull (Larus michahellis). In a within-clutch experimental design, 150 ng/g egg 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 amount of oxidant species (e.g. 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 (150.9±35.3 ng/g wet weight), while lower concentrations were found in residual yolk soon before hatching (2.9±1.1 ng/g wet weight). TCS was also detected in the liver (2.3±1.1 ng/g wet weight) and limitedly in the brain (0.2±0.1 ng/g wet weight).

TCS treatment did not significantly affect embryo morphological traits. However, TCS significantly increased ROS levels and promoted GST activity, leading to a marginally non-significant increase of both oxidative and genotoxic 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 overspill with herbicides and fungicides reduces chick survival in red-legged partridges
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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, potent herbicides and fungicides such as tebuconazole on embryonic development and post-hatching survival. Chicks were weighed and measured (tarsus length), and body condition calculated, at hatching and at days 8, 16, 24 and 30 post-hatching. Egg overspill with pesticides significantly increased chick mortality (Wald’s X² = 29.909, 14 d.f., p = 0.008). Although pesticides did not affect survivorship at hatching time, in ovo exposure to both 2,4-D and tebuconazole 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 nestling 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 overspill with pesticides can be a potential way by which these products can affect reproduction. However, further studies are needed to determine the effects of these compounds on the embryonic and post-hatching stages of the red-legged partridges. This study was focussed in two potential mechanisms of pesticide impact on avian reproduction 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
J.C. 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 (CPV). There are such group focused 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 Medicines Department; G. Cortés Ruiz, C. Rubio 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 Operational Protection Goals (“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 VMPs 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 environmental fate, and used for exposure assessments at field, field- 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. Ma, 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), trendione (TBO), 17β-E2, 17α-trenbolone (17α-T2), and estriol (E1). The similarity in chemical structures and metabolic 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 feedlot, field- risk 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 watershed, one in Texas and one in Iowa, using the U.S. EPA’s BASINS/HSPF 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, Biocides GSM GmbH Institut für Gewässerschutz; R. Duering, Justus Liebig University Giessen / Research Centre for BioSystems, Land Use, and Nutrition (IFZ), Institute of Soil Science and Soil Conservation

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 General Protections 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 regulators. This presentation intends 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 Estimation of insecticides in milk farms R.G. Ovesen, Danish Environmental Protection Age; H. Bækgaard, Copenhagen Fur

Biopesticides 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 milk farms. A scenario has therefore been developed, where emission of a.i. from milk farms is calculated based on either amount applied or measured concentration in straw. Default values have been established from regulation and general practice in milk production in the Nordic countries, where Denmark has the highest production of milk 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 cagels are retreated. Each mother will bear 5.53 cubs/year according to Danish regulation [4]. The number of ”breeding females” (BF) is 1 mothers+5.53 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 (n=2.75) 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 = Qmax x F x (Nstraw before sep + 3.75 x Nstraw after sep) x B x 10^0 (Eq 1) Where Y = emission of a.i. in kg/ha x year, Qmax is amount of product/nest box in g, F is concentration of a.i. in the product in kg/g, Nstraw before sep is number of treatments before separation of adults and cubs, Nstraw after sep is number of treatments after separation of adults and cubs and B is amount of straw/manure that may be applied to land in number of BF/ha (B = 50). Emission based on amount of straw/manure applied to the field: Y = Concentration of a.i. in straw/manure x 750 kg straw per BF/ha eq (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 Copenhagen Fur on amount of straw used per BF is 50 BF per ha x 15 kg straw per BF=750 kg straw per BF per ha. 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. Kümmerer, 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 (e.g. face wash) have already been discussed in detail. However, until now the specific sources from the interior of these households remained unknown. To investigate the products responsible for these emissions to wastewater, we analysed the wastewater of one neighbourhood for a set of biocidal active substances and compared these results with household product inventories. Time-proportional sampling of daily samples was conducted during one year for one household. The 14 substances investigated with an LC-MS/MS method were BIT, C12-benzalkonium chloride, carbendazim, CMIT, DCOIT, DEET, diuron, icaridine, OIT, piperoxyl butoxide (PBO), triclosan, tetrabononazol, terbutryn and tetramethrin. In comparison with data available from household product inventories of this neighbourhood, we investigated the product groups possibly being responsible for the emissions to the wastewater. Except for C12-benzalkonium chloride, C12-benzalkonium chloride, BIT, DEET and icaridine were measured in all samples. The results show...
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 icaridin 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 carbendazim are 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 produced 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 in 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 control solvent (NM100K DI), 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 in the treated test material. The adult 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 towards 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 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. Clark, School of Biological Sciences, Plymouth University; D. Boyle, Plymouth University; R. Hardy, University of Plymouth

Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has little consideration for engineered nanomaterials (ENMs). Given that ENMs undergo surface chemical reactions, agglomerate and sediment, assessment that has had little consideration for engineered nanomaterials (ENMs). Bioaccumulation and Animal Metabolism; K. Witte, University of Siegen / Department Bioaccumulation and Animal Metabolism; R. Louch, University of Manchester; R. Zeumer, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Bioaccumulation and Animal Metabolism

Eco-friendly and sustainable fisheries management strategies were set up and integrated at harvesting sites and ports. Fishermen were educated and encouraged to use sustainable practices. In the long term, these strategies led to an increase in the population size of the targeted species and a reduction in the use of chemical fertilizers. The integrated approach, combining ecological and economic perspectives, proved to be effective in achieving sustainable development in the fisheries sector.
(simulated) aged silver nanoparticles (Ag-NPs) in freshwater benthic organisms. In this study the pulmonary snail Physa acuta, the non-biting midge Chironomus riparius and the planarian Dugesia tigrina were used as test species. Pristine Ag-NPs of different sizes (3-8nm, 50nm and 60nm), a 27nm silver sulphide (AgS-NPs) simulating aging, and their ionic counterpart as silver nitrate (AgNO3) were tested. Bioaccumulation tests consisted of an uptake phase, where organisms were exposed to settled sediment and contaminated aqueous medium in a concentration of 10 μg Ag L-1, and an elimination phase where organisms were transferred to clean medium. Animals were sampled during the tests and total body Ag concentration was analysed by graphite furnace atomic absorption spectrometry. Kinetics of Ag-NPs and ionic Ag were described by one-compartment models. In this work, uptake and elimination kinetics of the different Ag-NP sizes were monitored comparing the uptake between organisms. Ag-NPs displayed higher k1 values which can be related to their higher exposure to settled Ag in the sediment. Larvae exposed to Ag 50nm showed the highest uptake rate constant (k1) and the highest elimination rate constant (k2), suggesting that Ag 50nm was easily taken up and eliminated from the body. Ag-S-NPs displayed a k2 close to zero, indicating that not only uptake was less in the larvae but also that they were less eliminated. Snails showed faster uptake and elimination of Ag-S-NP from the body compared to other Ag forms. For planarians, results revealed very similar k1 values, with the highest k1 for animals exposed to ionic Ag and the lowest for Ag 60nm exposure. Analysis of Ag in the sediment will be soon available to elucidate the behaviour of Ag, especially at the water-sediment interface, where most benthic organisms are exposed.

41 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 cell signaling, gene regulation and small RNA binding. A zinc finger consists of a mini-helix and a mini-sheet fold, and the ability of a zinc finger domain to interact with an AgENM depends on the peptide sequence. These results show that AgENMs can interact with Ag(I) at lower concentrations, and these interactions are pH-dependent. The addition of Ag(I) to AgENMs has been shown to affect the number of interaction points with DNA, RNA, and proteins, as well as the stability of the bound complexes.

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

43 Optimization of Oil Spill Response Planning and Preparedness Using Spill Mitigation Impact Assessment (SIMA)

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Oil spill emergency response plans (OSRP) are required as part of permitting for offshore operations. An OSRP typically includes risk assessment and detailed plans for responding to different types of oil spill accidents involving shipping, pipelines, platforms, and/or subsea wells. The owner/operator must demonstrate to state and federal regulatory authorities that the company’s OSRP for offshore exploration and production operations conform to all applicable regulations and international standards and practices, and further demonstrate that the necessary equipment and trained personnel are in place to respond quickly and effectively to an oil spill accident. In the event of an oil spill accident, the priorities for oil spill response (OSR) are to protect people, prevent or mitigate environmental damages, and prevent impact to affected communities. Spill Impact Mitigation 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 socio-economic 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 when new technologies and best practices emerge that need to be adopted into safety, health and environmental regulatory programs. This paper describes a spill impact mitigation assessment framework using recent examples of OSRP work 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, and (b) effectiveness and consequences of deploying different spill response strategies.
drawbacks of each option, thereby developing response strategy. Similarly, oil and gas operators 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, as it ensures 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

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In the field of oil and gas production, there is a constant challenge in developing new techniques of oil detection for prospection (natural seeps) and environmental monitoring, using oil range (0.6 to 2.5 g.kg\(^{-1}\)) TPH. Results indicated that the same techniques proposed, remote sensing, and especially hyperspectral spectroscopy, has provided promising results for the detection of oil 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 structure, pigments 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 6 to 25 g.kg\(^{-1}\) 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 clips 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-infrared wave band (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 conditions as in the field, using airborne hyperspectral imaging (TPH range (0.6 to 2.5 g.kg\(^{-1}\)) TPH). Results indicated that the same VI were highly correlated to TPH (r >0.7). Finally, VI allowed identifying the brownfield from an airborne hyperspectral image at high spatial resolution, and thus confirmed the potential of this technique for assessing environmental risks deriving from oil and gas production in vegetated areas.

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

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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 ecotoxicological dispersion associations, microbial oil degradation, oil-associated 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 improve pre-spill and post-spill measures to minimize the adverse ecological impacts of the next big marine oil spill, wherever it may happen. In this presentation, we demonstrate a convenient tool for keeping track of the large amount of ecotoxicological data and knowledge that typically emerges from research and monitoring after marine pollution disasters, using the DWHOS as a case study. In addition, we provide a summary of the new insights about oil spill effects on marine ecosystem that have been gained from the DWHOS research, and identify some key knowledge gaps still remaining. The presentation will update a comprehensive review about the environmental effects of DWHOS that we recently published in Marine Pollution Bulletin.

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

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What is the environmental effects of a beaches oil spill in the Arctic, how well will the shoreline potentially be able to self-clean and will combating 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 coast 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 west coast of Greenland. In another case, the tidal removal rates of the spilled oil on rocky surface were investigated at three locations of low Arctic, mid Arctic and high Arctic climatic regimes along the west coast of Greenland. The study included experiments of natural removal of a crude oil and a heavy fuel oil from tiles mimicking rocky shore substratum and was run in the period from May-September 2017. The tiles were placed in different height levels of the tidal zone, and hence 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 oils degrade and signature of compounds have been shown to change and 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 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 contain several homologues and analysis of the chemical signature during the Deepwater Horizon Response clearly indicated that several of these compounds were not behaving conservatively and were degrading at a faster rate than anticipated given the exposure time. Comparisons with the actual oil released clearly identifies the compounds most likely to alter the environments where they degrade. In this case, the Louisiana marshes were clearly a site where biodgradation was significantly faster than expected. This was also true of the alkylated PAHs which had been used as source identifiers in previous spills such as the Exxon Valdez. The 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 interpreting results 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 spill. If we want to conduct source apportionment, we may need to choose the most recalcitrant of the compounds rather than all of them.

Fish model species in human and environmental toxicology (I)

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 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 reverse transcription PCR was used to validate the expression of several miRNAs in the microarray data. The GO term analysis revealed that miRNAs significantly affected by BPS exposure were involved in hemopoiesis, lymphoid organ development, and immune system development. Among 14 miRNAs that were significantly regulated after exposure to 5 and 50 μg/L BPS, six miRNAs were selected to examine their roles in BPS-induced toxicity via the interference with the aromatization process. The results of this study will provide novel insight 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

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A variety of amphibious 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 (SeMet) at dietary levels (1.1 - 1.3 μg Se/g dry mass) 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 biomicroscopy. 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 ecophysiologica effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, this model system leads to the investigation of metabolic, energetic, and cardiovascular toxicities caused by excess dietary Se exposure, since similar responses following selenium over-supplementation have been reported in the human clinical toxicology literature. A proposed adverse outcome pathway (AOP) based on this study will be presented that links changes in gene expression to key events leading to adverse outcomes at the individual, and potentially population, levels of biological organization.

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

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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 mixture effects models. A combination of both approaches using chemical and bio- analytical tools for characterization for example of sediment contamination is expected to provide a more comprehensive picture of toxic risks to aquatic organisms. One of the most promising organsims 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 (i) to validate a screening approach for sediment of sample (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

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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). This has led to the realization that additional screening tools are needed to fully characterize the potential hazard to fishes due to the narrow range between essentiality and toxicity. Although few studies have investigated sublethal toxicological effects that may occur following dietary selenium exposure in adult fishes. Adult zebrafish were exposed to dietary selenium (SeMet) at dietary levels (1.1 - 1.3 μg Se/g dry mass) 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 biomicroscopy. 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 ecophysiologica effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, this model system leads to the investigation of metabolic, energetic, and cardiovascular toxicities caused by excess dietary Se exposure, since similar responses following selenium over-supplementation have been reported in the human clinical toxicology literature. A proposed adverse outcome pathway (AOP) based on this study will be presented that links changes in gene expression to key events leading to adverse outcomes at the individual, and potentially population, levels of biological organization.

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

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Zebrafish embryos are proposed and partially already used as replacement for tests with (adult) animals conducted for human and environmental hazard assessment. Zebrafish embryos can exhibit a limited biotransformation which could interfere with prediction of adverse effects for safety assessment. The concern was provoked by anecdotal observation of the lack of activation for some compounds suggesting that fish embryos are principally capable for metabolic transformation of chemicals (Kühnert et al., 2013, Environ. Toxicol. Chem. 32, 1819–1827). In order to assess the biotransformation more systematically we studied the biotransformation of two pharmaceuticals (clofibrate, celecoxib). Overall similar transformation products could be observed in zebrafish embryo as known from human studies. Interestingly, the ratios of the different products in fish embryos seemed to be different from the ratio in humans. Biotransformation is of particular relevance for compounds that require (metabolic) activation to elicit their intended biological effect or where activation “accidentally” produces more toxic substances. Organophosphates (OP) can serve as a model compounds for a proof of concept for activation in fish embryos as in many cases activation is mediated by cytochrome P450 oxidation. Therefore, we studied the
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 and that later embryonic stages may exhibit advanced biotransformation capacity.

54 Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses
C. Roper, 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 particulate matter (PM2.5) exposures. However, research groups are using different 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 prepared 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 components 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.

Safeguard and Conservation of Cultural Heritage: the contribution of chemistry

55 Cultural Heritage and Climate Change: impact and adaptation
C. Sabbioni, 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 the values and knowledge of the past to the future generations. It is urgent to include cultural heritage in the value chain of sustainable development: the priority of climate change at European level. Recommendations on the inclusion of cultural heritage in the national adaptation strategies and plans to climate change will also be discussed.

56 Nanotechnologies for the conservation and connected risks
M.I. Mosquera, Universidad de Cadiz

Most products commonly employed in the restoration and conservation of cultural heritage materials have not been specifically developed to preserve such elements. In addition, they are plagued by limited performance and structural drawbacks such as low adhesion, poor penetration, and cracking. Another disadvantage is the requirement for most products to be dissolved in volatile organic compounds (VOCs), which produce environmental and human health risks in their use. In this lecture, I will review the most meaningful achievements of my group in this field. We have developed an innovative sol-gel route for preserving Cultural Heritage 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”.

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

The European Research Infrastructure for Heritage Science (E-RIHS) entered the European strategic roadmap for research infrastructures ESFRI Roadmap in 2016, as one of the six new projects. E-RIHS 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-RIHS is a distributed research infrastructure with a multi-level star-structure: facilities from many Countries will be organized in national network, coordinated by several National Hub and RIHS headquarters will provide the unique access point to all E-RIHS services, by coordinating the net of National Hubs.

58 Discussion & Conclusions

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

59 Scenario Development for Off-field Soil Exposure and Risk Assessment
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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 identifies 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/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 specific GPs.

60 Biogenic residues formation from pesticides - an overview
K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); A. Möltner, 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), biodegraded by microorganisms, adsorbed 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 synthesize 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 different pesticides (2,4-D, glyphosate, metamitron, bentazon, bromoxynil and clodinafop-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
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 wash-off factor for FOCUS modelling based on literature research

S. Söttig, DR. KNOELL CONSULT GmbH / E-Fate Modelling; C. Wollmann, Dr. Knoell Consult GmbH; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety

After foliar application, plant protection products (PPPs) undergo several routes 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, PELO, 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 displaced substance depends on several factors. An ECPA working group recommended a harmonized experimental approach to derive wash-off factors in the greenhouse: a 24 h time interval between pesticide spraying and 10 to 20 mm of artificial rain, followed by an extraction 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 published literature was reviewed for the availability of data suited 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.

62 Application of a dynamic aquatic food web model for FOCUS exposure assessment

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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 substance’s 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 compound in the aquatic environment or biodegradation. A 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 log Kow 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 food web model for simulations of time-varying parameters typical of 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

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Hydrological processes 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 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 (Norway, Northern Italy), where more than 1000 ha of apple orchards surround the river and Institute of Bioeconomy Research; P. Horney, Julius Kühn Institut; D. Daehmlow, 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 by 2018, 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, SYNOPS, 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 VFSM.O.D have been incorporated in SYNOPS for a more realistic modelling of the runoff/erosion modules and the functioning of the vegetated filter strip. The Norwegian tool, SYNOPS-WEB, NORWAY 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. The model is based on a comprehensive database of environmental conditions, which is used to develop a risk assessment model for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tillage/mulch, 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 and discuss the mitigation measures implemented in SYNOPS-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.
65 Acute Toxicity of Pyrene Associated with Dissolved Organic Matter of Various Molecular Weights to Daphnia magna

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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 pyrene associated dissolved organic carbon (DOM-C_{pyrene}) was measured in 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 > lower molecular weight (LMW, < 1k 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_{pyrene} in the systems of MMW and HMW DOM, whereas increased when C_{pyrene} was at a low level and then decreased when C_{pyrene} was at a higher level in the control group with pyrene only and the system of LMW DOM. The influencing dosing from 10mM silicone rod has successfully been used in biodegradation and toxicity testing of 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

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There is regulatory and scientific attention on the fate, exposure and effects of chemical mixtures including complex mixtures of hydrophobic chemicals such 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 (UCVBs). 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 systems utilizing slow release devices in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of K_{ow} and K_{oc}. This study aims to extend the applicability of the novel passive dosing method to hydrophobic multicomponent substances and UCVBs (i.e. complex mixtures). The method is straightforward: a silicone rod is loaded by direct addition of the mixture and subsequently equilibrated 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 UCVB 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, CO2-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 14C-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. Tenax tube and the CO2-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=9) for Decane and 104.34% (N=9) 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 adsored 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

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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 model approach across the spectrum of OECD degradation tests with 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 14C 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 CO2, growth of degrading microorganisms and NER formation in aerobic degradation tests with selected 14C-labeled HOCs (triclosan, pentachlorophenol — PCP, propargite and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradations tests activated sludge or soil in novel passive dosing setups, in the framework of a single degradation test. Good agreement between model predictions and empirical data was shown by adjusting only the ratio v_{max}/K_{c}, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of v_{max}/K_{c} values was shown for the selected substances (0—55 mg C g^{-1} d^{-1}), indicating that both limited bioavailability and intrinsic recaclination 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

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Dissolved organic matter (DOM) is

on their Environmental Fate and Effects (II)

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70 Environmental occurrence and distribution of organic UV stabilizers in the sediment of the Bohai and Yellow Seas

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Organic UV stabilizers are of emerging 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 benzotriazole 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 reviewed in the next years. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-persistence. 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 150 °C. The extracts were solvent-changed to methanol, reduced in volume to 150 µL. The isolated samples were further processed on a LC-MS/MS system (Agilent Technologies, Germany) equipped with an API-socket and a C18 column (Eclipse Plus RRHD 1.8 µm, 2.1 x 150 mm, Agilent Technologies, Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the Bohai and Yellow Seas for the first time. 14 substances have been positively detected in concentrations in the low ng/g dw range. Characteristic pollution profiles and distribution pattern have been identified, which indicate to different indirect sources of UV stabilizers into the study area.

LCIA method developments in a global perspective: Status and outlook (l)

71 Implications of spatial differentiation on LCA-based decision-making: a case study of biochar systems in Indonesia

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The development of spatially differentiated life cycle impact assessment (LCIA) methods and their use in regionalized life cycle assessment (LCA) has intensified in the past few years. However, it is less investigated whether spatial differentiation leads to more correct decisions based on the LCA, in addition to just more accurate and realistic LCIA results. The aim of this work was to therefore assess the implications of spatial differentiation on the interpretation phase of a comparative LCA. Biochar production from biomass residues and its use as soil conditioner in Indonesia was used as case study. Comparisons were made between 4 villages, 3 biochar production techniques, and 2 fertilization strategies. Results showed that (i) regionalized impact scores for individual impact categories either increased or decreased compared with site-generic scores, depending on the impact category (by up to 1 order of magnitude); (ii) total damages to human health were approximately 3 to 5 times higher when compared to site-generic scores and (iv) irrespective of the geographic locations, regionalized damages to human health and ecosystem services. This is mainly because of trade-offs between categories, where increase in impact scores for some categories was compensated by decrease in others. Overall, irrespective of the approach to spatial differentiation in LCIA, biochar production and use in agriculture is generally expected to bring environmental benefits. When parameter and inventory uncertainties were considered, there was no significant spatial differentiation in terms 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 Con 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-generic 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.

72 Considering space debris related impacts within the LCIA framework

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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 CleanSpace 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, in the current studies adopt a Cradle-to-Launch pad 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 space missions becomes increasingly important. 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 lifecycle. Volume occupied 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.

73 Implementing ozone formation effects due to poplar plantations for biomass production in Europe - an impact assessment

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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 use poplar bioenergy for the production of 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 km²cyr⁻¹/km²yr¹) and consists of a fate 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. Torelli, Kruger A/S; H. El-taliawy, 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. Christenson, 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 (sandfilters), 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 2 h in biofilm systems. In this contribution it is highlighted which ecological conditions (aerated versus denitrifying; high and low BOD loads) have been found to favor degradation. 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 are 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 has been 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

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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 antioxidant using laccase enzyme, extracted from a white-rot fungus Trametes Versicolor, in the presence of 2,2’-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) diammonium 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 Es. coli culture and microbial disks. Results showed that 89% degradation of sulfamethoxazole can 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 degradation 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 could be addressing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

79 Evaluation of macrophage-toxic antibiotic transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays

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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. In this study, we included determination of the transformation 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 mM/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 alga 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. After biodegradation, the environmental relevance of the identified biotransformation products, some of which included previously unknown linearized TPs, was proven by screening the municipal wastewater extracts for their presence. The effect-driven evaluation of the studied transformation processes, based on toxicity to algae and residual antibiotic activity, indicated a significant reduction of harmful effects, however formation of numerous stable transformation products, warrants further ecotoxicological assessment.

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 in environmental matrices is increasing. However, traditional 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 sample treatment, namely Transesterification (TPs), in sewage and sludge using a fully automatized on-line 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 (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) (600±20 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±3%, 85±0% and 82±15%, respectively. COD concentration only affected clearly ibuprofen and naproxen REs. This pointed out oxidation as an important removal mechanism for those cases. In contrast, salicylic acid and triclosan REs slightly increased at lower COD loads. For propylparaben, high elimination rates (above 80%) were observed regardless 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 synergetic 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

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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 capability of activated carbons prepared from grape slurry for the abatement 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 three antibiotic residues in selected surface water samples using activated carbons prepared from grape slurry waste, and explored 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 and the drainage stretch of the Deep River at different 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 mechanism of the antibiotics. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediating the antibiotic contamination in the environment through using biosorbents prepared from grape slurry waste. The sorption data indicated that all the operating conditions employed in this study were crucial for the control of antibiotics adsorption. The percentage sorption was enhanced with increasing adsorbent dose, contact time and pH, while increasing initial antibiotic concentration and temperature did not favour the sorption of the antibiotics. The equilibrium data fitted satisfactorily into the three isotherms studied. The biodegradation 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

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Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove these compounds. Constructed Wetlands (CWs) have, however, been shown 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 uptake, translocation and metabolism of the organic pollutants. Two other experiments compared the effects of season, plant presence and plant species, initial concentration, hydraulic loading rate and CW design in different pesticides and pharmaceutical compounds. A sixth setup targeted the impact of support materials on contaminant sorption and biofilm microbial community function. The plants Typha latifolia and Phragmites australis were the most efficient plant species in removing ibuprofen and ibesoxet. Phragmites was the most efficient species to remove the pesticides tebuconazole and imazalil. Uptake, translocation and degradation of chiral pesticides inside the
plant tissue was documented. Formation of transformation products was assessed, but the mass balances were not closed. Organic micropollutants sorption to support matrix was low. Removal of different compounds was higher in summer than in the winter. Planted reactors showed higher efficiency than unplanted reactors, stressing the synergies between the plant and the microbial community. Unsaturated systems tended to be more efficient. Removal correlated with the nitrification activity and with the biofilm biomass, suggesting that bacterial processes play an active role in the micropollutants biodegradation. The removal of the organic micropollutants in CWs is affected by several design and operational parameters. Plant uptake does occur but phytoaccumulation is low as the compounds can be degraded inside the plant tissues. Due to overlying effect of the plants, the extent of microbial degradation could not be quantified. Further studies on transformation products in this type of technical systems are needed.

Wildlife ecology: laboratory dosing studies to field population assessments (II)

83 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/kg bw). We found that PAH exposure and pre-migratory fuelling rates 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 recurrent 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=35). Motus radio telemetry array technology was used to determine the arrival and departure timing and stopover duration. We found that 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.

84 PFAAs levels, oxidative status and reproductive success in great tits (Parus major) inhabiting a contamination hot-spot
A. Lopez-Arteaga, University of Antwerp / Biology; T. Groffen, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; L. Bervoets, Universiteit Antwerpen; R. Lasters, E. Prinsen, H. Abd Elgawad, University Antwerp; M. Eens, University of Antwerp / Department of Biology
Perfluoroalkyl acids (PFAAs) are substances which have been produced for more than 60 years. Their unique properties of repelling both water and oil, make them suitable for many industrial and consumer applications such as water and dirt repellents for clothes and carpets, active components in firefighting foams or precursors in Teflon® production [1]. Its extensive use, together with their high persistence, has resulted in global contamination of the environment, wildlife and even humans [2,3]. This ubiquity contrasts sharply with the limited amount of available information about their effects on wildlife. We report here on the PFAAs egg and plasma levels in wild populations of great tits (Parus major) settled along an established pollution gradient starting from a fluorochromelant plant in Antwerp (Belgium). Using two generations of great tits we have obtained important results in some poorly known issues such as the differences between sexes, maternal transfer of compounds or possible effects on the oxidative status or the reproductive success. The levels we detected in eggs and plasma, demonstrate that Antwerp is one of the major hot-spots in the world for perfluorohomologues pollution. With regard to the possible effects, negative correlations were observed between PFAAs levels in the eggs and reproductive parameters, including the total hatching success, eggshell thickness or the total breeding success. PFAAs levels in blood correlated with protein damage in adult birds while in chicks they correlated with higher activity of antioxidant enzymes (GPX and CAT). The obtained data represent an important step towards the understanding of the behaviour, effects and consequences of PFAAs in wild bird populations. [1] Buck RC, Franklin J, Berger JM, Cousin R (2011) Perfluoroalkyl substances in the environment: terminology, classification, and origins. Integ Environ Asses 7: 513-521. [2] Giesy JP and Kannan K (2001). Global distribution of perfluorooctane sulfonate in wildlife. Environ Sci Technol 35: 1339-1342. [3] Giesy JP and Kannan K (2002), Peer-reviewed: perfluorochemical surfactants in the environment. Environ Sci Technol 36: 146-152.

85 Active and passive monitoring of lead poisoning in birds of prey in Spain
R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicologia de Fauna Silvestre; E. Descalzo-Sanchez, Instituto de Investigación en Recursos Cinegéticos IREC CSIC-UCLM JCCM; P.R. Camarero, Pb concentration in captive León en Bosque. We have performed a passive monitoring by measuring blood (n=27) and liver (n=685) lead levels in birds of prey of 16 species found dead or sick in Spain between 2004 and 2017, but also an active monitoring by measuring blood lead levels in birds (n=196) and liver lead levels in dead or sick birds of 25 different species. P. Camarero et al. (2012) demonstrated that the ghrelin expression was downregulated by lead exposure, P. Camarero et al. (2016). The obtained data 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/kg bw). We found that PAH exposure and pre-migratory fuelling rates 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=35). Motus radio telemetry array technology was used to determine the arrival and departure timing and stopover duration. We found that 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.

86 Persistence of elevated p,p’-DDE levels and HCB-related protoporphyrin IX decrease in eggs of common kestrels from Tenerife (Canary Islands, Spain)
A. Buck, Instituto de Investigación en Recursos Cinegéticos IREC CSIC-UCLM / Wildlife Toxicology; J. Carillo, University of La Laguna; P. Camarero, IREC Instituto de Investigación en Recursos Cinegéticos; R. Mateo, IREC-CSIC-UCLM / Grupo de Toxicología de Fauna Silvestre
Persistent organochlorine (OC) pesticides, including p,p’-DDE, have been in common use in many parts of the world for more than 30 years, but they 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 published by the authors in open access (2021) showed that the occurrence of p,p’-DDE in eggs of West Canarian 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 Canarian common kestrel from Tenerife Island collected between 2009 and 2016. We have also measured the porphyrin composition of the eggshells to explore the use of these pigments as biomarkers of organochlorine pollution in birds. Biometry, status of embryo development and eggshell thickness were recorded from each egg and information about habitat characteristics were recorded for each nest. Because the eggs were at different degrees of desiccation, the content was lyophilised in order to measure OC concentrations in dry and lipid weight of content. OC analysis was performed by extraction with hexane-chloroform mixture (1:1, v/v) followed by the development of these pigments in thin layer chromatography (tlc) followed by O-diazotisation of these pigments with hexahexamethonium chloride (hhex) and resuspension in n-hexane, followed by four clean-ups with sulfuric acid and determination by GC-ECD. For porphyrin determination, eggshells were homogenized and extracted with acetonitrile:HCl 3N (2:1) and then
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 general linear models with the surface of active and abandoned cropland in a 200 m-radius 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. Proporophyrin IX was the only pigment in eggshells and its concentration 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. Shore, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Crosse, The Vincent Wildlife Trust; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hankle, 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 δ13C/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. 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 recolonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

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 / Ecotoxicology & Stress Ecology Group

89 The threshold option, the recovery option and landscape modelling
P. Thörbek, Syngenta / Environmental Safety; N. Galic, Syngenta / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior
Landsapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the delivery of service depends on the weather and farming activities. The emergence of the action level approach (where population trajectories are used to identify the population abundance at which an expected change in an ecosystem service will occur) has been complemented by the emergence of the threshold level concept (where the maximum population density at which an expected change in an ecosystem service will occur is identified). Understanding ecological threshold options can help make decisions on population management of species or populations. The optimal population management strategy may be different to the optimal population abundance (e.g. biomass or functioning) that would be set for lower tiers of the risk assessments, which may be easier to measure. In some cases the ecological production functions are quite simple if a population directly delivers the service (e.g. for angling). However, in other cases, the link is far from straightforward and such ecological production functions have largely been ignored in pesticide risk assessment. This should be a priority area for future research.

90 Understanding risk - a better approach to reduce uncertainty
M. Wang, WSC Scientific GmbH / Dept E fate Modelling; M. Froudoulias, Dow Agrosciences / RSERA 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 (focal 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 for answering questions on the relevance of effect size in 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.

91 Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms
E. Ziółkowska, Jagiellonian University / Institute of Environmental Sciences; J.C. Topping, Aarhus University / Department of Bioscience; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group
Crop species richness and population sizes in agro-ecosystems have decreased dramatically during the last decades in Europe and worldwide. The current scheme of agrochemical intensity 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 viable 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 relevance of 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 or grassland). The framework allows for testing in silico critical scenarios. This should be a priority area for future research.

92 Where are the Springtails? A vertical distribution model for C. diaphana across time and space
G. Hantke, University of Exeter / Centre for Ecology & Hydrology; M. Ross, Jagiellonian University / Ecotoxicology & Stress Ecology Group

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University, Institute for Environmental Research / Institute for Environmental Research

With respect to environmental risk assessment it is crucial to know where and when to protect an organism but still little is known on the dispersal of collembolan communities in agricultural landscapes. Especially for the environmental risk assessment of plant protection products vertical movements can be relevant for exposure assessment of in-soil organisms. Thus, ecological modeling offers a powerful tool to link exposure and effect. We will present the individual-based model of the soil-dwelling collembolan *Folsomia candida* FOLCAS (*Folsomia candida* simulation). FOLCAS is a vertical distribution model simulating an agricultural soil column, which can be applied to demonstrate the effect of variations in environmental parameters on the population and its dispersal. In addition, the model features the option to evaluate the effect of a pesticide application. The model consists of two submodels: the lifecycle and the movement submodel. The movement of the individuals in FOLCAS is influenced by temperature, pore space, pH and the organic matter as a proxy for food availability. In order to assess the importance of food availability as a main trigger for movement a vertical distribution experiment was designed. In this experiment we assessed the vertical dispersal of *F. candida* in OECD soil in relation to food location and time. Transparent PVC columns were filled with 350 g OECD soil up to 20 cm column height and 86 individuals of *F. candida* of different age classes were added. Each column was divided in 6 compartments from top to bottom: 0-1cm, 1-2.5cm, 2.5-5cm, 5-10cm, 10-15cm and 15-20cm. The location of feeding was varied by four different regimes while all other parameters were kept constant (2 replicates per regime). The dispersal of *F. candida* within a soil column is influenced by the location and availability of food. The study will give insights not only about the population dispersal in relation to food as a single stressor, but also on the population composition. The movement submodel will be incorporated and simulation results of the vertical dispersal of collembolans will be presented. A case study will be used to elucidate the importance of the vertical dispersal of non-target arthropods in effect assessment.

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A practical application of an individual-based stickleback model in the ERA of PPPs

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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 (IBM) allow for the incorporation of individual variability, population-level interactions, and specific behaviours. 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 from obtained field data. 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.

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Using the Bayesian network relative risk model to integrate molecular effects, ecological context and ecosystem services to estimate risk over space and time with *Folsomia candida*

W. F. Neubauer, Wageningen University / Ecotoxicology; J.D. Stark, Washington State University / Dept of Entomology; K. von Stackelberg, NEK Associates LTD / Department of Environmental Health; C. Mitchell, Washington State University / School of the Environment; Y. Chu, Western Washington University / Environmental Science; M. Harris, Whatcom Conservation District / Institute of Environmental Toxicology; L. Wallis, Western Washington University / Institute of Environmental Toxicology

An ongoing dilemma in risk assessment is the perceived difficulty in successfully integrating scales that range from the molecular to ecological, timescales from days to decades, and endpoints that can be species specific to a host of ecosystem services. Starting in the late 2000s to now there has been an interest in defining ecosystem services and in the calculation of risk to these properties. It has been suggested that ecosystem services are a method to encourage a systems approach to sustainability. Human well-being has become part of the lexicon to included endpoints such as a sense of place, education, employment, public safety and traditional activities. In a recent publication (Harris et al. 2017) it was demonstrated that it is possible to estimate risk in a contaminated site to ecological endpoints, human health and ecosystem services using a clearly defined causal pathways and Bayesian networks. Now we are extending the integration of ecological endpoints, ecosystem services and human well-being from the scale of a contaminated site to that of the Salish Sea. The Salish Sea is a term applied to both the Puget Sound and its watersheds in the United States and the Straits of Georgia in Canada. Vancouver, Seattle, Oregon, Tacoma, major ports, numerous refineris, paper mills, and high tech industries. The same area is also noted for intense agricultural use, outdoor recreation and the harvest of marine resources. The region is also home to more than 30 recognized Tribes in the U. S. segment and First Nations in Canada. We will use three watersheds in this region, the Skagit, the Nooksack and the Cedar as case studies. Time frames will be from current conditions to 2070 and will include climate change projections for temperature and precipitation. We will demonstrate the application of the Bayesian-network relative risk model to integrate pesticide effects at the molecular level and the alteration of watersheds to calculate risk to the ecological endpoint Chinook Salmon, the specific economic ecosystem services provide by the endpoint and the watersheds, and finally demonstrate the risks to human well-being as defined from a variety of cultural perspectives.

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

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Mobilisation of silver sulphide nanoparticles in soil column by earthworms’ bioturbation

M. Baccaro, Wageningen University / Toxicology Department; H.H. van den Berg, Wageningen University / Dept of Toxicology; D. Hermans, L. Sloot, 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 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±20.4 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, 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 spICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms overtime. 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.

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

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 (ReSoL 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag\text{dig}) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol incubation showed the highest remobilization of Ag which was below 2% of the Ag\text{dig} concentrations in the soil columns. The correlation between remobilized Ag\text{dig} and Ag\text{dig} 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 remobilization. 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\text{dig} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag\text{dig} 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 higher Ag ENP application.

Ag ENP were induced to homogenous distribution in the soil and therefore, a small change in concentration 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 values for nominally 20 and 80 nm citrate coated gold ENPs (Au ENPs), as well as 30 nm sulphonated silver ENPs (Ag\textsubscript{S} ENPs) were induced to a random distribution by shaking and the filtered soil solution was distributed into 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 nitrogen recovery of the ENPs in the break through curves. Preliminary results show no significant differences in the 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 gave 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 minimize a proportionality 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.

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

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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 digested and combusted under anaerobic and aerobic 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 sulfides, the remaining fraction was best described by a ZnO reference spectrum. For sludge spiked with ZnO-NP, a lower degree of sulfidation (~5% ZnS) with a concomitantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a spectrum of Zn 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% Chalcoyprite, indicating that Cu was not completely oxidised during the combustion. Comparable from CuOOH and CuSO\textsubscript{4}, and ‘truly’ dissolved Cu was returned from LCF analyses. All Cu spectra of the sludge and the ashes were similar 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.

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

J. Merten, Precious Metals and Rhenium Consortium c/o EPMF; K. Arigs, ARCHE; É. Smolders, Katholieke Universiteit Leuven; D. Leverert, 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 nanofoms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanoform with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~75% ZnS)) with an 'atmospherically standardised' test design. "Truly" dissolved Ag in porewater qualitatively explained observed toxicity of silver nitrate compared to soil sludges. "Truly" dissolved Ag in porewater was measured (MCP-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, but decreased in the following 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.

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

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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 where, unless soluble, interacts mainly by aggregation, 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 homoggregation. However, integration of this process into fate models and exposure assessment requires parameterisation 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 homoggregation. 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 homogeneous aggradation 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 homogenization conditions complex enough 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 homogenization 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)

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MC-252 biomarkers as indicators of oil exposure and pollutant concentration in sediments of the northern Gulf of Mexico

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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 isoelectric point/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 contaminated sediments. 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 shalding 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 transects. A main effects-model used in the current 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.

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Downregulation of hsp90 and increased intermolt duration in the blue crab, Callinectes sapidus, in response to oil exposure

S. Chiaison, 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. Many commercially and recreationally important species reside in or near the area of the spill. The blue crab, Callinectes sapidus, is common in the NGOM and is both economically and ecologically important in this region. In this study, after exposing juvenile blue crabs (Callinectes sapidus) to crude oil using a suite of tested and validated tests, we tested for the relative expression of heat shock protein 90 (hsp90) by measuring the corresponding mRNA expression. Expression of hsp90 is normally upregulated in response to thermal, or environmental stress, and it also plays an important role in the regulation of estrogen dependent cell signaling. We also monitored crabs over two molts to test for effects on growth after exposing crabs to oil. Expression of hsp90 was significantly downregulated in dispersed crabs exposed to the oil but not oil alone. This suggests that dispersed oil interferes with either the pre-mRNA transcription of hsp90 or potentially causes alternative splicing of pre-mRNA.

hsp90 expression in crabs exposed to oil alone was slightly elevated, although not significantly. However, the intermolt duration of crabs exposed to oil increased, meaning that exposure to oil results in delayed molting and therefore slower growth.

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Physiological and molecular impacts of crude oil and/or dispersant-contaminated seawater and sediments on the sponge Halichondria panicea (phyllum Porifera).

J. Vital, 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, Geoscience, 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 (spunge 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 physiologic 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-hycyclic aromatic hydrocarbon (AHCs) are a class of organic contaminants exposure to seawater or sediments contaminated with Schiehallion crude oil and/or Slickgone NS dispersant in H. panicea. Sponge respiration rate and filtration rate (by clearance rate) were measured throughout exposures, and tissue samples were collected for evaluation of the transcriptome. Throughout the exposure experiments, respiration rate displayed a high inter-individual variability, consistent with scientific literature. A decreasing trend in respiration rate was observed when sponges were exposed to contaminated seawater or sediments. Filtration rate was significantly decreased in sponges exposed to contaminated seawater or sediments, and filtration rate did not recover for 48h after the end of the exposure to contaminated seawater. The transcriptome has been sequenced and analysis is underway to detect changes in gene expression patterns associated with treatments. Overall, results indicate that sponges respond to short-term exposure to crude oil and/or dispersants by cessation of their filtration behaviour. These initial results and our ongoing investigations will contribute to better understand the sensitivity of marine sponges to oil production activities.

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Advances in the effects of UV on oil toxicity in aquatic organisms

A.P. Roberts, K. Bridges, 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. Krasnec, Abt Associates; M.L. Gielazyn, NOAA / USEPA Region IV

Polycyclic aromatic hydrocarbons (PAHs) are a class of organic contaminants that are toxic to many aquatic biota. PAHs are bioaccumulative and can be persistent in the environment. PAHs can be found in natural sediments or may be introduced to the environment from anthropogenic activities such as oil production. PAHs can enter aquatic environments through various routes including atmospheric deposition, runoff, and direct discharge from point sources. PAHs are known to have a variety of toxic effects on aquatic organisms, including acute and chronic toxicity. Acute toxicity of PAHs can include effects on respiration, reproduction, and survival. Chronic toxicity can result in long-term changes in physiology and morphology.

The objectives of this study were to: (1) determine the physiologic 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-hycyclic aromatic hydrocarbon (AHCs) are a class of organic contaminants exposure to seawater or sediments contaminated with Schiehallion crude oil and/or Slickgone NS dispersant in H. panicea. Sponge respiration rate and filtration rate (by clearance rate) were measured throughout exposures, and tissue samples were collected for evaluation of the transcriptome. Throughout the exposure experiments, respiration rate displayed a high inter-individual variability, consistent with scientific literature. A decreasing trend in respiration rate was observed when sponges were exposed to contaminated seawater or sediments. Filtration rate was significantly decreased in sponges exposed to contaminated seawater or sediments, and filtration rate did not recover for 48h after the end of the exposure to contaminated seawater. The transcriptome has been sequenced and analysis is underway to detect changes in gene expression patterns associated with treatments. Overall, results indicate that sponges respond to short-term exposure to crude oil and/or dispersants by cessation of their filtration behaviour. These initial results and our ongoing investigations will contribute to better understand the sensitivity of marine sponges to oil production activities.

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Photoenhanced Toxicity of Petroleum to Aquatic Invertebrates and Fish: Review of the Science

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. Many commercially and recreationally important species reside in or near the area of the spill. The blue crab, Callinectes sapidus, is common in the NGOM and is both economically and ecologically important in this region. In this study, after exposing juvenile blue crabs (Callinectes sapidus) to crude oil using a suite of tested and validated tests, we tested for the relative expression of heat shock protein 90 (hsp90) by measuring the corresponding mRNA expression. Expression of hsp90 is normally upregulated in response to thermal, or environmental stress, and it also plays an important role in the regulation of estrogen dependent cell signaling. We also monitored crabs over two molts to test for effects on growth after exposing crabs to oil. Expression of hsp90 was significantly downregulated in dispersed crabs exposed to the oil but not oil alone. This suggests that dispersed oil interferes with either the pre-mRNA transcription of hsp90 or potentially causes alternative splicing of pre-mRNA.

hsp90 expression in crabs exposed to oil alone was slightly elevated, although not significantly. However, the intermolt duration of crabs exposed to oil increased, meaning that exposure to oil results in delayed molting and therefore slower growth.
M.G. Barrow, 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). This study used an outdoor setting under natural conditions of sunlight, wind and rain, and provides a case study that will be a 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. Brigham, University of Texas / 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 to organic forms, such as methylmercury (MeHg). 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 marine acid transporters with the potential to cause severe, irrevocable effects on developing organisms. Here, we describe the development loss in the diluted-treated microcosms slowed down, which could indicate a 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.

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. Eiesen, 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 the toxicological and endocrinological effects of EDCs. Here, there is an urgent 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 across species and stages of development and lifespan of organisms. Molecular toxicology pathway models to predict outcomes of regulatory relevance for the selective serotonin 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 differences in gene expression in fish livers 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 livers and brains, respectively. Of these, 238 (59%) and 236 (55%) matched unique gene names. In WS, 252 and 192 contigs were significantly altered in livers and brains, respectively, with 145 (58%) matched unique gene names. This study will be the first to use FLX to evaluate the impact of EDC exposure on the brain and liver of fish using RNA-Seq analysis. Overall, the results of this study will be compared to apical outcomes assessed in a parallel chronic study, and which will allow the ability 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. Brander, Oregon State University / Environmental and Molecular Toxicology; B. DeCourten, 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. Menhinto, 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 vertebrates. Because the dopaminergic system is highly conserved among taxa, we sought to confirm the altered dopamine concentrations in P. promelas brains 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 scenarios 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.
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 atricolic follicles, and developmental defects are more pronounced in F1 embryos and larvae relative to parental. 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 and imaging for a better understanding of ecotoxicological mechanisms - PAH developmental toxicity as an example
E. Vehmaäinen, C. Rigaud, A.N. Eriksson, University of Jyväskyla / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; A. Rokka, S. Saraa, 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. Kaukonen, 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. Raininbow trout (Oncorhynchus 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 gathered 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 also 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-Jara, Universidad de concepcion / Biomarcadores; S. Casini, University of 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 concepcion / Cellular 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 intervention 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 irwini (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 proplastic 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 of complex chemical mixture and establishes the possible relationships between the physiological/reproductive alterations observed and the high degree of intervention of this river.

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

113 Can the Agenda 2030 and the Sustainable Development Goals be the drivers to change the world?
E. Giovannini, ASViS

114 How the SDGs are being addressed in Horizon 2020
M. Tamborra, European Commission - DG Research and Innovation

115 Examples of EU projects related to SDGs
M. Recchiotti, European Commission - EASME

116 Why SDGs are relevant for a large enterprise
A. Valcalda, ENEL

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

118 Questions and answers

Mercury Biogeosciences - Fate, Effects and Policy

119 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. 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 bond 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 metal mercury. Metall mercury is a subtle neurotoxicity 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 pollutants 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

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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 mercury toxicity have been found in several studies. The protective effects of Se on mercury biogeochemical processes that promote this antagonistic relationship. In fact, only two published studies have simultaneously examined the interaction of Hg and Se. We tested this hypothesis in our study. These results suggest that Se inhibition of MeHg accumulation might occur both at the microalgal and macroinvertebrate levels.

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, UnMOM3.REDU. Results help in estimating 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, confirming the phosphorus limitation (P-limitation) on relations between different mercury fractions, uncertainties in key output results, such as evasion of mercury from ocean to atmosphere, are also reduced. From factor 650 to factor 50, and in net reduction of Hg(II) to Hg(0) in atmosphere from factor 36 to 10. Analysis of contribution to variances of inputs to output variances suggests that, still, parameters describing oceanic processes such as partitioning between suspended solids and water, and mercury redox transformation in oceans contribute more to variances in key model outputs, compared to parameters such as global mercury emissions. Therefore, more 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

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Bioavailability and realistic risk assessment of organic...
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in 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 release technology tool for assessing the risk of non-polar and ex-situ non-polar chemicals in sediment porewater. For deducing truly 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 spiked 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 Horten 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 addition, 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 results showed that both the in-situ and ex-situ data for 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 disk passive dosing

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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 to our group on whole sediment-suspended silicon rubber (ESR) 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 compared 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 (SPME) 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. SPME samplers in sediment had 1-3x lower concentrations than SPME 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 SPME 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 insecticidally contaminated sediment comparable to much more elaborate 28d whole sediment tests. Also, at lowest tested toxic insecticide levels, concentrations in SPME extracts were close to detection limits, so accurate measurements of safe bioavailable chlorpyrifos concentrations via SPME 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

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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 2 h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integr Environ Assess Manag. 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retroactively 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 desorption PTFE-PARs) were compared to different operational conditions ranging from a different time scale to dissimilar treatments (planting, biofouulant 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. Harmesen, 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 dry cleaned sediments were spiked with PAHs. PAHs were measured in the original sediment and resulting soil. 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. Using PAHs as indicator, the last was measured. 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 20°C gives the fast desorbing fraction applied at 60°C gives the slow desorbing fraction. Measuring the total 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 soil the different bioavailable fractions were measured and used in 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 biobar and compost amendment on the behaviour and toxicity of tar mixtures in
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 organic carbon and available carbon concentrations of both compost and fractions as well as HMs were determined after 0, 30, 90 and 180 days. Further to this microbial biomass, soil respiration, phospholipid analysis, Microtox toxicity, earthworm’s 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, microcosms 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 rape 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. Finskas, 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 its bioavailability is largely determined by the plants physiological ability to undergo pyrolysis (decomposition 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 often 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 (sulfamethoxazole (SMZ) and trimethoprim (TR)), an anticonvulsant that prevents seizures and relieves nerve pain (carbamazapine), an antidepressant (fluoxetine (FLX)), and an antihyperlipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and its influence on biological properties and toxicological responses in mixed contaminated soils.

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

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

M. Niuehe, TU Berlin / Sustainable Engineering; R.K. Rosenbaum, National Research Institute of Science and Technology (WULCA) resource group framework.

Freshwater resource has been recognized as being a safeguard subject within the Actual Protection (AoP) natural resource (WULCA resource group framework). Freshwater resource has been recognized as being a safeguard subject within the Actual Protection (AoP) natural resource (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 of the dynamic fate guidelines has been implemented in 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 m3/100 (in kg/day). Then, the quantification of the effect factor is based on the concept of adsorption processes with activated carbon. This allows for an indicator based on physical properties of the pollutant which is (i) substance specific, (ii) dependent on the level of pollution (i.e. chemical mass in freshwater), and (iii) proportional (although not covering energy requirements) to the effort necessary to fully remediate the persistent pollution. Therefore, the substance-specific characterization factor has a unit of mass equivalent of activated carbon per kg emitted [kgem cry/kg] and represents a midpoint. It does not describe the effects of a specific load of pollutants, but rather a potential load to which the system is exposed. The load needed to indicate the potential effort required to recover the pristine freshwater resources depending on the persistence of the pollution and its difficulty in being remedied. Thus, this approach provides a new perspective allowing more transparent results for the differentiation of safe, long-term water supply risks (AoP natural resources) and potential (short-term) toxicity effects (AoP human health).

133 Towards global regionalized characterisation factors for water consumption impacts on instream freshwater ecosystems


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 methods) or on stress-indexes (what we called second generation methods). 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 footprints (flow to atmosphere) 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 to an integrative, 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 comprehensive water consumption and environmental footprint. Implementation of these guidelines is now being considered. Limitations of the current approach are discussed, but also alternative methods are also considered. The new methodological guidelines wish to harmonize current and future methods under a unique framework and to enhance the environmental relevance of the water use impact category in LCA.
quantify potential water consumption impacts on freshwater ecosystems. In existing mechanistic models, mostly based on species-discharge and species-area relationships, ecological requirements are not taken into account. This implies considering equal response to stress for different taxa, overlooking the relationships between species and their habitat, along with other aspects of biodiversity (e.g. abundance). In this study we want to show the importance of habitat modelling to describe the impact pathways of water consumption on ecosystem quality. We propose a new mechanistic LCA model based on freshwater modelling and discuss the applicability at the regional and global scale. Water consumption may alter stream discharge and other related physical variables. Habitat suitability equations can be used to quantify physical habitat availability for freshwater species in Weighted Usable Area (WUA). Starting from WUA equations, a Habitat Characterization Potential (HCP) indicator for river fish species is employed and invertebrates is proposed and applied in France at Q50 (wet season) and Q90 (dry season) flows. HCP represents the change of available habitat area deriving from river discharge alteration. At the river reach scale, HCPs from different taxa have been aggregated under different perspectives in order to test the results’ sensitivity to negative and positive effects of hydrological alteration. A spatial aggregation has been also performed on the waterbodies and sub-waterhed levels. Subsequently, the global HCP model’s applicability has been discussed. HCP is highly correlated with river size. The aggregation at reach scale is driven by specific taxa and by positive HCP scores (habitat loss). The result of the aggregation at watershed is consistent with existing evaluations of hydromorphological pressures in Europe. The main challenge in applying HCP globally is due to hydrological and hydraulic data availability. It is however possible to find consistency 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 computable spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

134 The use of dynamic stock model to the definition of characterisation factors for biotic resources depletion
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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 resources depletion very well. 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 of the present work is the use of this knowledge to assess biotic resources depletion in LCA. This is illustrated by the definition of characterisation factors (CF) for fish stocks depletion. The relationship between inventory and impact is often determined by the marginal effect where the CF is used for quantifying marginal change in impact according to a marginal change in inventory. Here, the Depleted Stock Fraction (DSF) is considered to be the assessed impact while the elementary flow of the inventory is a mass of fish removed from the biomass stock. The marginal approach is applied to the Schaefer model, a commonly used model in fisheries representing the dynamics of the biotic stocks. It combines catches, current biomass and maximum intrinsic growth rates of the stock (population). To determine these parameters for most of the world fisheries, catch time series were used for species of FAO Global Fishery and Aquaculture Statistics. This allows assessing all fisheries of the world in the LCA framework with a midpoint biotic resource depletion impact. To our knowledge, this work is one of the first assessments of biotic depletion in LCA, based on a model of population dynamics. We are confident this will bring improvements to the LCA of fish-based products, allowing for the comparison of different fishery alternatives with respect to the use of marine biotic resources. One of the extensions of this present work could be the definition of CFs for terrestrial biotic resources where similar dynamic stock models are used. This advocates the use of a similar approach based on population model dynamics for both terrestrial and marine biotic resources.

135 Accounting for soil quality effects of agricultural land management in LCA
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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 intensities should be distinguished. We therefore introduce three interdependent LCIA indicators. At early midpoint, SOC changes (SOC2; indicator 1) are used to indicate the long-term effect of agricultural land use. 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 characterization 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 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

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (III)

137 For scale WWTP balancing with passive samplers offers new insights in xenobiotic elimination processes
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Calculating elimination rates for full scale wastewater treatment plants is very demanding because it requires the knowledge of mixing regime to match inflow to out flow volumes which translates very often in sampling campaigns that span over several days. While a certain progress in understanding elimination processes of xenobiotics has been gained from laboratory reactor tests, reliable and large datasets from real-life full scale plants are still missing due to the cumbersome sampling effort. Here we implemented the use of passive samplers to establish chemokinetics with the simple concept of using recalcitrant compounds like carbamazepine to normalize sampling rates from in- and outlets of treatment plants and hence be able to directly calculate elimination rates. The method was validated in a pre-study with parallel autosampling and then applied to 18 WWTPs representing a large range of design properties such as hydraulic and sludge retention times. Normalisation with carbamazepine and lidocaine proved to be robust since both inlet-outlet ratios were well correlated and elimination rates of the investigated compounds fell into the ranges documented in literature. Furthermore it was possible to identify patterns of elimination by applying a cluster analysis and several compound elimination rates were found to negatively correlate with sludge retention time and hence to be more related to active biomass of the sludge. Inlet loads of the compound could be calculated by calibrating the more invariant outlet concentrations to passive sampler masses and then back calculating to inlet loads via the elimination rates. Population equivalent loads proved to be within expected ranges from the literature and non-domestic sources could be identified. Passive sampling might hence close the gap of investigation in xenobiotic behaviour on full-scale treatment plants and serve as well as a routine performance surveillance tool.

138 Screening of wastewater-borne pharmaceuticals and their phototransformation products in rivers
S. Sjöblom, N. Montemurro, IBAEA-CSIC / Environmental Chemistry; D. Barceló, IQBAR-CSIC / Department of Environmental Chemistry

Pharmaceuticals are continuously discharged into the rivers from wastewater treatment plants. Hundreds of wastewater-borne pharmaceuticals have been detected in river samples but their concentrations along the river change constantly due to additional inputs and natural attenuation processes. Apart from biodegradation, drugs can undergo phototransformation reactions by either direct or indirect photolysis including reaction with singlet oxygen (1ΔO2), hydroxyl radical (•OH), peroxyl radicals (•OOR), photo-excited organic matter, and other reactive species. To evaluate these processes in a river, usually laboratory studies are
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 TPAs 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. Using UPLC-TOF-MS to identify photo-TPs, 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 of 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

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 anoxic/anamox reactor (ANA). Several polymer-attached probes were tested in four WWTPs. 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
g. vüksek, Universite de Sherbrooke / Civil Engineering

In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problems that 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, but also 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 discharge limits, it is also important to decrease human footprints in wastewater. Selection of appropriate enzymes is therefore an important parameter for the optimization of the process. Several methods have been elaborated, but the most appropriate one is based on the use of Laccase, which is capable of converting unreactive iodide into iodine, which can be used as a disinfectant. 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 anoxic/anamox reactor (ANA). Several polymer-attached probes were tested in four WWTPs. 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, Universit de Sherbrooke / Civil Engineering
catchment delineation, conventional geographical modelling is combined with life cycle impact assessment (LCA) 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. Confront with the inaccessibility of the 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 organic and inorganics such as persistent organic pollutants and heavy metals. Although 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.

4.4 Combining economic modelling and LCA to assess regional policies: key learning points from a case study on the French forestry sector

T.B. Beaussier, 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 of system aggregation and differentiated scenarios (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 organic and inorganics such as persistent organic pollutants and heavy metals. Although 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. 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 of system aggregation and differentiated scenarios (industries, households, manure and pesticides application on agricultural soils). It relies on existing and public...
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 Swiss 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, different regions and different land use categories. 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 finding and implementing refurbishment programs to future mobility solutions such as autonomous vehicle systems.

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

Modelling ecological scenarios for the assessment of chemical effects on stream communities
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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.

Robust implementation of TKTD models with Bayesian inference
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The application of toxicokinetic-toxidynamic (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 (PPPs), ...). 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 toxidynamics 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 dynamics. For 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. Under governmental 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. In To model the effects of Cowboy-fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS models using the software R. To software, the project was implemented using 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.

Can TKTD-models describe and predict synergistic interactions in Chironomus riparius?
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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 toxidynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study is to predict the same α-cypermethrin TKTD-effect model 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 competitive interactions of the azoles and α-cypermethrin was a range of tests conducted with co-exposure to 1, 3, 10, 30, or 100 µL L⁻¹ of propiconazole or prochloraz and 2.5, 5.0, or 10.0 µL 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 adding the internal competitive interactions to the observed survival rates. We hypothesize that the synergistic interactions can be described and modelled by adding a synergy parameter "s" to the biotransformation rate constant for α-cypermethrin and that the value of this "s" parameter will depend on the 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 explore the hope that models can be used to test the predictions of the TKTD-framework and to model the exposure of the midge larvae to azole and pyrethroid pulses with varying time intervals between the pulses.

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-toxidynamic (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. 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 compared to the TKTD framework GUTS, which has been adapted to account for higher temperatures than 20°C. These models have been applied to the midge larvae 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.
New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment

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 stages (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 modelled effects were consistent from the fish model to 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 the cyfluthrin ingested is removed from the fish and the fry have little reserves 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 UMIR 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 (IBMs) was suggested as relevant tools. Furthermore, IBMs 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, which the organism communication dynamics which make their calibration and development costly. 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-known and a DEB model for this organism has already been developed. In this study, we used data from several mesocosm experiments to describe stickleback populations under control conditions, and exposed to three concentrations of an endocrine disruptor, the Bisphenol A (BPA, 1, 10 and 100 μg/L). First, using two sets of experiments in control conditions, different ways of integrated temperature and food data was used in order to assess the relevance of the DEB model calibrated with laboratory data for sticklebacks in mesocosms. Then, the DEB-IBM was developed and calibrated and simulated endpoints of the population dynamics in control conditions were compared to the observed endpoints of the population dynamics in control conditions or exposed to BPA. We showed that the DEB model successfully predicted the growth of mature male and female sticklebacks for two sets of experiments in control conditions. Furthermore, the calibrated DEB-IBM successfully predicted the endpoints of stickleback populations during mesocosm experiments in control conditions. Indeed, the different descriptive variables of the populations (population size, male, female and juvenile frequencies, lengths and coefficient of variations) were well described and were used to compare with the endpoints of mesocosms exposed to BPA. In conclusion, simulated endpoints of stickleback populations can thus be used as a baseline to compare exposed populations to BPA in order to improve environmental risk assessment. In a second step, the DEB-IBM could be adapted in order to introduce the effects of toxicants such as BPA on the individuals and thus extrapolate the effects at the population level.

155 Atmospheric Microplastic’s: A novel method for the identification of microplastic’s in the inhalable size range

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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 nanoplastics (NPLs) and microplastics (MPLs), respectively. The quantitative analysis of these plastic fragments, 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 analytical tools for the quantitative and qualitative analysis of MPLs/NPLs using three techniques to assess the physicochemical properties such as Thermogravimetric Analysis or TGA, Differential 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 ionisation (ESI), Atmospheric Pressure Chemical Ionization (APCI), Atmospheric Pressure Photoionization (APPI), Matrix-assisted Laser Desorption Ionization (MALDI), Desorption Electrospray Ionization (DESI) 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

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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 defeation,
retained in the digestive system, and 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 controlled environment to two nominal concentrations (2 and 4 mmol L⁻¹). Low and high MP dose, respectively) of microalgae (MA) (Isochrysis galbana, clone 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 volatility of selected small MP species was observed after the mussels 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 increased 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 pseudofaeces. Results showed that after 120 hours of the exposure the 6% and 8% 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.

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**Analysis of tire wear particles in environmental samples using TEG-DC-MS**

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In this contribution we present the analytical method development based on Zn and S content and apply the analytical method to determine tire wear particle concentrations along the treatment path of road runoff. Tire wear particles have been recognized as an important environmental pollutant. Analytical methods for 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) volatile assisted acid digestion and elemental detection (ICP-MS) and sulphur and carbon. A stepwise method development including analytical methods 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 17000 mg/kg (± 1700 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 02WS1378H) and BBW for provision of samples.

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**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. Vorschmidt, German Federal Institute for Materials Research and Testing / 5.3 Mechanics of Polymers.

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 area is essential, 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 defining and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get a broad 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)**

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**Behavioral and physiological responses of biclor damselfish and mahi-mahi to olfactory cues following crude oil exposure**

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In fishes, olfactory cues provide information about predators, prey, and conspecifics that is crucial for survival. 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
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 flame emission system. Accelerated yolk sac depletion, accelerated yolk sac depletion, and alterations of buoyancy in developing embryos. Furthermore, brief exposures during embryonic development lead to reduced swim performance, reduced maximal oxygen uptake, and reduced visual acuity in later stage juveniles. Juvenile fish exposed to oil showed altered olfactory responses, reduced prey capture ability, and higher susceptibility to predation, likely due to altered central nervous system function. Even adult marine fish are sensitive to brief, low-level oil exposures, showing reduced aerobic scope and swim performance. The lower ability, and higher susceptibility to predation, likely due to altered central nervous system function. Over the last decade, the use of the m halibut and mahi-mahi nursery stocks is critical to successful larval rearing. 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 crude oil exposure and additional environmentally relevant stressors, such as high temperature and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, prolonged 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).

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

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The Deepwater Horizon oil 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 crude oil exposure and additional environmentally relevant stressors, such as high temperature and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, prolonged 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).

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Impacts of Oil Exposure on Mahi Embryos

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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 crude oil exposure and additional environmentally relevant stressors, such as high temperature and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, prolonged 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).
166 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; G. Xu, UC Riverside / Department of Environmental Sciences; Developmental cardiotoxicity is a common phenotype observed 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 stages 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–miRNA 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 15b, were also upregulated and inorganic 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

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

M.J. Araujo, CESAM & DeBio / APPLEP; 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. Sousa, 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 senegalis 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 indirectly changing abiotic conditions, such as ultraviolet (UV) radiation. Therefore, in this work we aim to understand the effects of different stressors to early life stages of S. senegalis, namely of UV radiation and of the organic compounds 4MBC, Carbendazim, Linuron and Triclosan, which have potential endocrine disrupting and larval stages of development. While functional inhibition, 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-day full metamorphosis progression of S. senegalis. Exposure to UV radiation and to the four organic compounds (compounds 4MBC, Carbendazim, Linuron and Triclosan) was performed. Our results suggest that S. senegalis is a very suitable vertebrate model for ecotoxicity testing requires the evaluation of effects at different development 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. senegalis 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.

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

D. Basili, University of Liverpool / Institute of Integrative Biology; M. Knobel, Eawag / UTOX; A. Sawle, Cancer Research UK Cambridge Institute / Department of Systems Biology; J. Herbert, P. Anton, University of Liverpool / Institute of Integrative Biology; K. Schirmer, Eawag / Environmental 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 such alternative 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 (Oncorhyncus 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.

169 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. Therefore, in spite of several available alternative methods and computational approaches that do not need 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. Furthermore, in spite of several assumptions and simplifications, 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.

170 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. Belanger, The Procter & 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 Environmental Stewardship Centre for Sustainability Environment and Health; B. Farr, 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 HCPC 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-Observed 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 also 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 a chemical risk MoA, integrated 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 Biobased Ecotoxicology; N. Klüver, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; D. Kerkhof, Helmholtz centre for environmental research - UFZ / Department Biobased Ecotoxicology; M. Leonard, IOREAL SA; T. Kießling, Scientific Software Solutions; R. Altenburger, UFZ Centre for Environmental Research / Department Biobioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Biobioanalytical Ecotoxicology

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 (structural MoA, site specific risk assessment, mixture, product development, criteria development). This presentation will discuss and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

172 Poster spotlight: MO158, MO159, MO190

Migratory bird species at risk - the role of pesticides and other chemicals

173 CMS talk setting the scene for the CMS working group on poisoning and outlining CMS needs in terms of scientific input from SETAC
B. Heredia, UNEP/CMS / Avian Unit

174 Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO456
C.A. Bishop, Environment and Climate Change Canada / Wildlife Research Division

175 Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO457
P. Pommier, VETAGRO-SUP / Toxicology

176 Main scientific gaps in knowledge of risk from Pb ammunition and shot to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO458
R. Croning, Wildfowl & Wetlands Trust

177 Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO459
M. Tagger, University of the Highlands and Islands / Environmental Research Institute

178 Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally - POSTER SPOTLIGHT MO460
M. Odino, Independent Environmental Services Professional

179 Questions and discussion

180 Regulatory view describing the extent to which [if any] regulation takes into account neighbouring country/regional use of compounds, accounts for how local use might affect migratory species, how field data on migratory species might feed into regulatory R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit

181 Panel discussion with audience and presenters focusing on how SETAC can interact with CMS usefully to provide scientific evidence and expertise Challenges in setting, meeting and measuring specific protection goals for plant protection products

182 Towards a more holistic environmental risk assessment approach of crop protection products as tools in agriculture P. Dobmen, BASF SE / Environmental and Consumer Safety, Ecotoxicology

Currently, very complex risk assessment approaches are conducted for crop protection products. This is largely justified as pesticides are intentionally 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
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 food production, with 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 evaluation in the conceptual 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 Science
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 it to identify what portfolio of services are required, by whom and where they should be protected. But how does one go about prioritizing preferences so that they contribute to identifying the services to be protected and how should preferences be assessed? These questions are particularly pertinent when considering the role of the general public in protection goal prioritization. Here we use information from case studies in the UK and China to investigate the importance of: who you ask (do different sections of society have different preferences?); what they know (how does prior knowledge influence preferences?); how preferences are assessed (e.g. stated v revealed preferences). We demonstrate that all three factors can have an impact on which freshwater ecosystem services are preferred by the general public and therefore should be prioritized for protection.

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. Roman, Bayer CropScience AG
Currently there are 3 Scientific Opinions from EFSA that are waiting to be developed into Guidance Documents i.e. 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% was suggested there was data to support it but in fact it was still a judgement, i.e. it is a hidden ‘judgement’. The suggestion that there is a logarithmic relationship 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 view, it is recommended we have a more evidence-based 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 keystone 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 Committee addressing the state of the science on 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 addresses the protection of plant species growing in-field that under current agricultural practice would be considered target weeds if growing in the cropland per se. However, the two key options for setting SPGs, provided by non-crop plants growing in-field, have been discussed in various stakeholder workshops and publications. Proposed options for protecting in-field ecosystem services include (a) compensation mechanisms whereby designated areas are set aside specifically for NTPPs, and (b) beneficial weed protection, which involves the control of those weed species that compromise crop yield while not affecting other species that are considered to have ecosystem service value. This second option relies upon the availability of highly selective herbicides and/or other methods of selective weed control. In order to inform this debate, the feasibility of beneficial weed protection will be considered from three perspectives: (a) issues relating to the definition of beneficial weed species (b) potential agronomic consequences of protecting beneficial weeds and (c) challenges facing the landscape that conservation of specific herbicides poses (d) Feasibility of selective weed control. The issues outlined in this presentation will illustrate that the feasibility of protecting weeds in-field requires investigation of complex species definitions and agronomic consequences while the discovery and availability of new herbicides with the required selectivity is considered unlikely, particularly under the current regulatory framework in the EU.

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. Clunn, 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 be on Ecosystem Protection Goal (EPG) as defined for surface water 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 wellbeing). 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 ecological and protective 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 biodevise aquatic communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment endpoints are those that reflect molecules and trophic-based effects, and those that preserve the biodiversity of ecological and functional 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; J. Chinn, Centre for Crop Health and Protection (CHAP)
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. Magurran 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 design units. With this contribution we explore different approaches to quantifying effects of treatments on structure and function of plant and soil 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 microbiota 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. Uhlík, University of Chemistry and Technology, Prague; E. Zucchi, M. Morosini, 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 biodiversity of the soil microbial community, a series of plant species were selected as potential phytoremediation treatments for the development of a suitable rhizoremediation 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 to 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 hydrolytic 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 Phialitis arundinacea. This species cultivated in conditions of redox cycle showed to stimulate the highest increase in soil microbial activity after 3 months from planting. Molecular analysis of the 18-month biostimulated soil was incubated with 14C-labelled 4-chlorobiphenyl, the production of 14CO2 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. Caffaro, Università di Bologna / Chemistry and Technology; R. Rosi, Università di Bologna / Department of Earth Sciences; M. Bacchi, P. Foglietto, Goria, J. Birstingl, Regenesis Ltd; S. Rosati, Università La Sapienza / Chemistry; F. 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 mbd in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a result of oil spills and oil derived pollution. 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 petroleum contaminated groundwater. A lab-scale prototype of the bioremediation system was the object of the present work. This innovation was the object of the “bioelectrochemical well [1]” that has been realized and operated in a continuous-flow regime using first tolune 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 BE:ERAGE - BioElecElectrochem RemeDiation of Groundwater plumes (2015-0195). [1] Palma E., Daghio M., Franzetti A., Petrangeli Papini M., Aulenta F. Bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. Microbiotechnol., 2017. doi: 10.1111/1751-7915.12760.

190 Identification of major HMW-PAH degrading communities during active bioremediation of a PAH-contaminated groundwater J. Vilà, Instituto de Recursos Naturales y Agrobiología; M. Grifoll, Universitat de Barcelona / Dept. Genètica, Microbiologia i Estadística; M. Aitken, University of North Carolina / Environmental Sciences and Engineering; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica y Conservación del Suelo

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) in soils is generally constrained by their low availability to microbial communities. As a result, a recent research perspective is to employ bioelectrochemical systems (BES) for the in situ treatment of PAH-contaminated groundwater, 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 (95%) of the total PAH concentration. Low molecular weight (LMW) compounds (2- and 3-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 10^3 to 10^10 copies/g dry soil) during the initial 45 days, associated with major PAH removal. 16S rDNA gene sequencing revealed distinctive profiles for both indigenous and introduced communities that evolved with time. Gene expression analysis of ring hydroxylating dioxygenases, together with changes in pyrosequencing libraries, identified members of Pseudomonas as the main LMW-PAH degraders. In contrast, dioxygenases of
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-HMA-PAH removal identified members of the recently described order *Immundisolitobacteriales* and members of *Sphingobium* as the main active populations. Their role on HMW-HMA-PAH removal was confirmed by DNA-SIP. Members of *Immundisolitobacteriales* and *Sphingobium* had major phylootypes that dominated the microbial assemblage, which matched members of *Immundisolitobacteriales* clearly predominated in incubations with 13C-pyrene and 13C-benz[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 mycobacteria to the degradation of the more labile fraction of HMW-PAHs. Their increase in activity during the late incubation phase, when degradation kinetics were drastically attenuated, suggested their potential action on the residual fraction of contaminant.

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Stable Isotope Raman Microspectroscopy and Surface-Enhanced Raman Scattering: Analysis of Microorganisms at Single Cell Level

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Microorganisms play a vital role in most ecosystems. They are essential for global biogeochemical cycles and for biodegradation of soil and water pollutants. Therefore, it is crucial to develop reliable and sensitive methods for the detection, discrimination and identification of microorganisms as well as for analysis of their activity. Raman microspectroscopy (RM) in combination with a stable isotope approach (SIRM) is an emerging tool for the nondestructive characterization of the molecular and isotopic composition (due to a red-shift in Raman spectra for heavier stable isotopes) of microorganisms at the single cell level. [1-3] SIRM allows for in situ investigations of ecophysiology and metabolic functions of microbial communities. Furthermore, the sensitivity of RM and SIRAM analysis can be significantly improved (in the range of 10−10 to 10−13) due to surface-enhanced Raman scattering (SERS), e.g., by using of Ag nanoparticles synthesized in situ. In contrast to RM and SIRAM (where whole-organism fingerprints for bacteria are obtained), SERS is more selective and provides information on cell surface substances. We applied SIRM and SERS for analysis of unlabeled, 13C- and 15N-labeled single bacterial cells.[4-6] Single cell SIRM analysis was carried out for the *Delagatus polyesteraphidum* strain N47, a strictly anaerobic sulfurea-reducer, degrading the recalcitrant environmental pollutant naphthalene. For the 13C-labeled N47 cells peak pattern from isotopeologues of phenylalanine with 0, 2, 4 and 6 13C atoms was found even though this strain is a strict anaerobe growing on 13C-naphthalene. Additionally, our results suggest an incorporation of hydrogen carbonate from the medium into biomass during growth of strain N47 on naphthalene. Furthermore, SERS analysis of *E. coli* revealed that the SERS signal intensity and shape varied with the level and type of different factors (storage time, presence of D2O and) and can reflect the metabolic activity of cells. Our findings can open new possibilities for the application of SERS (in combination with a stable isotope approach) to probe for the activity of pollutant degrading microorganisms at the single cell level. [1] Berry B, et al. 2015. Proc Natl Acad Sci USA 112: E194-E203. [2] Wang Y, et al. 2016. Curr Opin Biotechnol 41: 34-42. [3] Ivkova NP, et al. 2015. Anal Chem 87: 6622-6630. [4] Kubyk P, et al. 2015. Anal Chem 87: 6622-6630. [5] Kubyk P et al. 2016. Analyst 141: 2874-2878. [6] Weiss R, et al. in prep.

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Flux chambers data for the estimation of the biodegradation rate in the subsurface at hydrocarbon contaminated sites

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The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microorganisms has been shown to be a very effective tool in eliminating ground- and outdoor 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 then evaluate 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 around 6 hours. Before starting the measurement, the achievement of steady-state conditions inside the chamber was assured by purging at least 4 chamber volumes through an inert gas. The measurements were carried out in 14 sampling points of the site over 1-4 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

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The end of an era: is data and model exchange across LCA software tools finally possible?

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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 significant product environmental footprint category (PEFCRs) and organization environmental footprint sector rules (OEPFRs), 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 will be a starting point for discussions about the need for new data exchange standards. 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-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.

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LCA using real time information: the case of DEA-enabled monitoring of WWTP lifecycle environmental performances

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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 databases now allows access to 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 not an 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
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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 (LUC) 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 and the factors that transform the land use trends. The agricultural and land use module in EXIOBASE make use of FAOSTATdata, 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, NOx, NOy, NH3 and resource inputs of accelerated denaturation 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 50-300%, and for primary plastics 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
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ELSA-PACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Istea; G. Junqua, Ecole des Mines d’Alès / 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 procedures 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 a WSMix framework for modelling current and prospective WSMix (WSMix) and an inventory database for direct use in LCA. To demonstrate the relevance of including WSMix and P-WSmix in LCI databases, case studies have been conducted. To develop the WSMix framework, system boundaries have been defined and variables in classification and terminology of water sources and users have been harmonized. A WSMix database for different users has been developed and a technological matrix has been established to link water sources to water production technologies and energy use. To develop the P-WSmix, a methodology based on algorithms enabling to obtain prospective WSMix (P-WSmix) is proposed. Data on water demand and water availability projections for different scenarios and time horizons have been used. The WSMix includes a framework, a WSMix database and technological matrix, the P-WSmix includes also a framework, a P-WSmix database and electricity mix and technology evolutions. The WSMix database covers 93 countries at different spatial scales for various users. The P-WSmix covers 73 countries at national scale for two users under different scenarios and time horizons. It has been shown that the environmental impacts of supply public water are highly dependent on the country and change over time. The inclusion of WSMix and P-WSmix in LCI databases is relevant for a more consistent water-use related impact assessment and for the LCA of infrastructures or products with a long life span.

198 The evolution of database- and tool development for Agri-Footprint
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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: Unraveling behavioural responses to chemical contaminants in the environment

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
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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 irbesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L; 200 ng/L, 20000 ng/L, for temazepam and irbesartan, 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. Irbesartan 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 relation to the biomarker results emphasising the importance of 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
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Sciences

The capacity of pharmaceutical pollution to alter behaviour in wildlife is of increasing concern to the scientific community. A major pathway of these contaminants into the environment is the treatment of livestock with hormonal growth promotants (HGP), highly potent veterinary pharmaceuticals that can enter 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 HGP to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (2-fold) to field-detected levels (β-agonists) of an array of pharmaceuticals on larval chironomids (Chironomus plumosus) under laboratory and field conditions. Treatment with fluoxetine (30 µg/L) resulted in a significant increase in swimming activity and a decrease in foraging activity, indicating that drug exposure may alter key aspects of fish foraging behaviour. This study presents the first evidence that 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 pharmacologically 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 of fish to environmental contaminants?

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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 contaminants? In this research, which was designed to determine the effect of long-term (21 day) exposure to field concentrations of pharmaceuticals (HGPs), highly potent veterinary pharmaceuticals that can enter aquatic ecosystems via effluent runoff, on behaviour, exposed fish spent a greater total amount of time within a foraging zone containing of 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 increase in feeding rate of chironomids on three microalgal species, independently. Therefore, thereby affecting 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 pharmacologically 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.

205 Effects of fluoxetine on anxiety-related behaviours and physiology in a songbird

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Several species of bird are known to forage directly on invertebrates at wastewater treatment plants (WWTs), 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 environmentally relevant concentrations in wastewater. 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 fluoxetine on anxiety-related behaviours and physiology in a songbird, 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 fluoxetine birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that fluoxetine-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, fluoxetine causes vasoconstriction, which in birds will affect the ability to thermoregulate. This study provides further evidence that low, environmentally relevant concentrations of pharmaceuticals can cause sublethal 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?

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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 benzytolazol, 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 by a factor of 10, and observed how many exceedances existed per site and how they changed with time. 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 macro invertebrate 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

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“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 epidemiology. This presentation is a recent gold-digging trial, with surprising results. We collated biomonitoring and mixture exposure data from the Dutch Waterboards, as collected due to obligations of regulatory frameworks (such as the Water Framework Directive). We quantified for each sample, based on measured chemical concentrations, the mixture toxic pressure at EC50-level. Outcomes were expressed as multiphase Potentially Affected Fraction (mPAF-EC50) of species-specific Species Sensitivity Distribution (SSD). Earlier research suggested that this proxy – higher values of which are interpreted to imply a higher potential for species loss – has a gross absolute relationship with species loss in various regional studies. In the current study, we overlaid the SSD-model basis (all species are unequal in their sensitivity to exposures) with this finding, by analyzing tissue-specific threshold values. That is, we determined the tissue-specific mPAF-EC50 beyond which species abundance starts changing when toxic pressure rises, in a downwards (sensitive) or upwards (indirect opportunistic response) direction. The results show a series of species-specific mixture exposure thresholds, and an overall assemblage-level (aggregated) exposure threshold. These outcomes are compared to simpler approaches, such as quartile regression on the species assemblage level, as well as multi-stressor statistics. We conclude that the set of species-specific and assemblage-level thresholds bear important contextual information to judge our risk assessment and management foundations, be it in the realm of prospective Chemical risk assessment or of the retrospective Environmental risk assessment and management.

208 How much improvement in wastewater treatment benefit downstream macroinvertebrate populations?

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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 1990’s 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 any factors that could support downstream macroinvertebrate communities from the application of tertiary granular activated charcoal treatment (GAC) lasting from 2008 to 2014. No new macroinvertebrate families appeared during this period. The steady improvement in macroinvertebrate diversity in an effluent dominated river implies that current chemicals in domestic wastewater are not noticeably harmful to these organisms. This implied that provided we can achieve a 90% percentile BOD below 5 mg/l and 0.05 mg/l NH4 below 0.6 mg/l in the effluent then the macroinvertebrate diversity will steadily improve (within the limits of habitat suitability). The small river has a population of stickleback and other fish but their 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. Andrew C. Johnson, François Edwards, Monika D. Jürgens, Helen Vincent Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 8EB, 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

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Fish health depends upon the state and quality of the aquatic environment. Changes in physical condition of fish may therefore be attributed to changes in environmental quality. Based on time series of 20 years of biometric data of bream from multiple sampling sites of the German environmental specimen bank (ESB), we assessed which biometric parameters and indices of bream are suitable indicators for long-term changes in fish health and environmental quality. The length and weight of individuals of a defined age, hepatosomatic index and with restriction the condition factor and lipid content of bream are reliable indicators for long-term changes of fish health and hence hint at long-term changes of environmental quality. We show examples for current trends of these indicators in German river systems. Our results confirm the high value of biometric parameters for monitoring of long-term changes in state and quality of aquatic ecosystems.

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

S. Deltcheva, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; N. Poulet, Agence Française pour la Biodiversité / Pôle Écohydraulique, AFB-IMFT; A. BESNARD, 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 strategies. It also essentially depends on species-specific life cycle species: freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology....
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 (quantiles 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 pattern here observed. Among the demeographic 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 can explain both 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 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. Hippe, Swedish National Environmental Monitoring; G. Malarvannan, University of Antwerp / Toxicological Center; J. Søndergaard, Aarhus University / Arctic Research Centre; K. Thorup, A. Toptrup, 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 associated past, present and future health risks. We have established a retrospective examination of Mercury (Hg) and several organohalogen contaminants (OHCs) in Swedish, Norwegian and Greenland 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 ratios. 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 was of the same order of magnitude as the average PCB exposure in Sweden. Changes in concentration levels and PCBs and PCBs and PBDEs over time were clearly associated with changes in human activities. 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 was of the same order of magnitude as the average PCB exposure in Sweden. Changes in concentration levels and PCBs and PCBs and PBDEs over time were clearly associated with changes in human activities. Strong evidence for spatiotemporal patterns was found based on preliminary results for Hg and OHCs in the Swedish and Norwegian populations.
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 developed. The species tested were the great pond snail (*Lymnaea stagnalis*), 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 µg/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 toxicity tests conducted with *Chironomus riparius*, *Ceriodaphnia dubia*, fathead minnows, and the algae (*Pseudokirchneriella subcapita)* 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 quality and quantity. 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 as inputs of the 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 as inputs of the 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 as inputs of the 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 as inputs of the 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 as inputs of the 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.

### 218 Closing the gap between small and smaller: Towards a framework to analyse nano- and microplastics in aqueous environmental samples

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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 aqueous 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 nanoparticles from 100 into 0.5 L and yields in a reproducible particle recovery of 54.2 ± 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 pyrolys 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 aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microparticle mass spectrometry for the analysis with FTIR-microscopy. By this, the results of spectroscopic 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 of natural matrix and microplastic particles and fibres

F. Schmidt, M. Schmiederer, Eawag — Swiss federal Institute of Aquatic Science and Technology; D.M. Mitrano, 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 analysis, 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 (Pd, 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 in 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 mixed liquor in batch experiments, representing 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 plastics are an exciting new tool to study the fate and fates of microplastics in fresh and marine environments 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


The presence of large quantities of plastic waste and its fragmentation in various media (polystyrene, polyester, polypropylene and low density polyethylene). Each variant has an embedded metallic fingerprint (Pd, 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 in 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 mixed liquor in batch experiments, representing 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 plastics are an exciting new tool to study the fate and fates of microplastics in fresh and marine environments 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.

221 Soil and sludge: A time and cost-effective method for extracting microplastics from complex, organic-rich environmental matrices

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The very little existing work on the analysis of 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. Extractions using the incorporation of sludge samples including density separation. 7 reference polymers were used: HDPE, LDPE, PP, PS, PET, PC and PA-66, which account for >70% of global plastic demand. Degradation was observed for several of the reagents and selected polymers. NaOH treatments caused the most significant changes, including degradation of PET and PC. Small degradative changes occurred as a result of peroxide oxidation and KOH treatments. Fenton’s reagent, NaOH and KOH treatments were not effective in sufficiently reducing organic material whilst peroxide oxidation and Fenton’s reagent removed the majority of organic material. Based on these results, Fenton’s reagent was identified as the optimum treatment and was further optimised. Phase 3 tested revealed high extraction efficiencies for this protocol. This study results in a 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 treatment plants

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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 microplastics 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 microplastic 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 detected using FT-IR. All particles (n= 60) were confirmed to be plastics. Polyethylene particles were the most common (30.5%) followed by polyethylene terephthalate (26.7%) and polypropylene (20.3%). 62% of plastics were extracted during the low density (1 g cm⁻³) separation steps and 38% were extracted at high density (1.8 g cm⁻³). Results between WWTPs 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 million 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

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Key to understanding the fate of microplastic particles in fresh water 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
Air Pollution, Biomonitoring and Human Health (I)

224 Particulate matter in indoor academic environments: chemical composition, sources, infiltration from outdoor
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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<sub>10</sub> and PM<sub>2.5</sub>) 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 weekends 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<sub>2.5</sub>sampling 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) of the filters. PM<sub>2.5</sub> in the indoor environments was dominated by the organic fraction, with a relevant contribution of the bioaerosol, mainly in the coarse fraction. The infiltration of particles from outside constituted a significant source of inorganic species. A vertical gradient was observed for soil components. A relationship of the concentration and composition of indoor PM with the volume of the classroom, height from the ground, presence/absence of the students and distance from the street has been highlighted.

225 Source apportionment of major species and metals in PM<sub>2.5</sub> in urban sites under industrial influences in northern France
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PM<sub>2.5</sub> 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 city of Dunkerque 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<sub>2.5</sub> and on the identification of their sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using Digita® 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<sub>2.5</sub> composition was analyzed for major elements, trace elements and PAHs. A combination of SOPs was applied. Specifically 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<sub>2.5</sub> was thus quantified using a weighted non-negative matrix factorization based receptor model that considers constraints on chemical profiles (CW-NMF). NO<sub>2</sub>, SO<sub>2</sub>, NH<sub>3</sub> and TC were found as the major contributors of PM<sub>2.5</sub> (between 75% and 95%). Significant differences were evidenced. Trace elements (Cr, Zn, Ni, As, Ag, Cd, Cu, Mn, Pb, V, Sn, Rh, Sr, Bi, Ba, Co, Sb and Ti) only correspond to 0.30% to 0.45% of the PM<sub>2.5</sub> 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 provided useful information on industry source emissions and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM<sub>2.5</sub>, such industrial sources were the main contributors of metals at the two sites.

226 Estimating the contribution of deposition in the total exposure to PAHs in order to derive save deposition reference values
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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 sink processes 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 yearly average concentrations in air and particulate matter (PM<sub>10</sub>) 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 exceedance, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were ran for 16 priority EPA - PAHs + benzo[j]fluoranthene. For only 4 PAHs sufficient measurement data are available in the EFSA database to perform a reality check. Of these 4 carcinogenic PAHs, only the calculated exposure to benzo[a]pyrene exceed the TDI with a factor 4, implying that current deposition rates might be too high. More deposition measurement data for Bra/IP are required to confirm these results. (The authors thank the Flemisch Agency for Health and Care for their support)

227 A bioassay-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air mass contaminants
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Air quality is currently assessed by monitoring a few pollutants involved in the respiratory diseases of vulnerable groups. However, the factors controlling the buoyancy or sinking of particles are not well known as they are for other chemicals/particles, like phytoplankton and sedimentary material. Herein we present the results of linking experiments with PM<sub>2.5</sub>, covering different shapes (spheres, fibres, irregular), microplastic densities and surface water properties, 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.
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 presenting a higher endocrine-disrupting effect, especially estrogenic. In order to identify the bioactive compound families responsible for this endocrine-disrupting potential, a bioassay-directed analysis was developed and may represent an advanced biomonitoring tool for air quality. The gaseous phase was collected in a Parisian building during cold season (winter 2014) and in sufficient quantities (6 consecutive samplings of 15 days) to implement the entire fractionation process by semi-preparative liquid chromatography: split of the initial organic extract into three fractions, each fractionated into three subfractions. All these samples and the multiple controls were submitted to the chemical analysis (68 target EDCs) and the biological analysis (estrogenicity measured by transactivation cellular assay). After applying the UHPLC conditioned target EDCs in the biological assays, we identified a total of 14 EDCs in the first fraction (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 nonylphenol. The data suggest however the involvement of non-studied EDCs in this biological effect. Our data confirm that biosaas represent suitable biomonitoring tools to assess air quality, whether they are associated with the chemical analysis or not.

228 The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health
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As energy efficient buildings and communities continue to grow, energy retrofits and new designs need to be made in concert with improvements in indoor air quality (IAQ). Although thermal renovations may decrease heat loss and reduce energy expenditures, inversely, envelope improvements (airtightness) can impact infiltration and air exchange rates, and magnify the effects and intensity of internal air pollutants. In this context, a pilot study was conducted to evaluate the health risk associated with exposure to indoor air pollution in eight buildings ranging from green certified (i.e., LEED Platinum, Living Building) to historic archetypes. The buildings represented the broad spectrum of conservation design, which is situated downwind of major industrial point sources. Indoor and ambient measurements of particulate matter (PM10, PM2.5), black carbon, ozone (O3), total volatile organic compounds (TVOC), carbon monoxide, carbon dioxide (CO2), relative humidity, and formaldehyde (HCHO) were collected on a seasonal basis. The heterogeneity in ventilation type along with the negative effects of deficient heating and aged mechanical systems had on indoor air quality was distinct; however, the counterintuitive findings implied that green and naturally ventilated buildings underperform when compared to some the conventional buildings within our study. The CO2 sensors used in most green buildings respond to the number of occupants within a space but does not consider ambient concentrations of criteria air pollutants (i.e., PM2.5, O3, NO2) before increasing outdoor air volume. Natural ventilation systems that supply outdoor air to indoor spaces in the absence of mechanical filtration, and in turn compromise the health and well-being of building occupants. Additionally, green and high-performance buildings are equipped with state-of-the-art HVAC systems that work in tandem with occupancy sensors to optimize energy use when buildings are occupied and minimize energy use when buildings are vacant (overnight). To this end, with our limited sample size, our results provide insight and evidence of energy management systems (VOC and HCHO levels overnight). In this given case, the use of occupancy sensors did not allow proper flush-out of indoor environments and indoor finishing prior to the building being opened for operations, and as a result, increases exposure over the lifetime of the building.

229 INNOVATIVE AND LOW-COST MONITORING TECHNIQUES FOR EVALUATING THE SPATIAL VARIABILITY OF PM COMPONENTS: VALIDATION AND FIELD APPLICATION
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A new very-low volume sampler has been developed with the purpose of allowing spatially-resolved determination of atmospheric particulate matter (PM) and of 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 analyses. This device can be validated during a study focused on the concentration of PM10 mass, ions, levoglucosan, polyyclic 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 PM10 mass concentration and its main chemical components in the area of Terni, a urban/industrial hot-spot situated 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 biomonitors for PM spatially resolved analyses. The meteorological conditions of Terni basin, which limit the dispersion and enhance the accumulation of atmospheric pollutants, are ideal to test and validated 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
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Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that univocally 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 gametas 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 biomarkers 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 recorded 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 currently in progress. References (1) Forbes VE, Calow P, Silby RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994, (2) Lacaze E, Gefoard O, Geyot D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cell with reproduction impairment, using the Comet assay. Environmental Research111:626-634

231 Species differences of bioaccumulation, biotransformation and synergetic effects of two fungicides in two aquatic invertebrates
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Numerous micropollutants have been detected concurrently in aquatic systems, but little is known about the mixture effects of micro pollutants in aquatic organisms and the underlying mechanisms. Azole fungicides are known to act synergistically with other chemicals by inhibiting cytochrome P450 (CYP) catalyzed detoxification and thereby enhance the effect of already toxic substances in different organisms. Two widely used fungicide classes co-occur in surface water are strobilurin and azole fungicides. This study aimed to investigate the species' sensitivity to both fungicide classes and to gain mechanistic insights on potential synergistic effects of azoles on strobilurin fungicides in non-target organisms. Therefore, we determined the toxicokinetics of a strobilurin fungicide azoxystrobin and an azole fungicide prochloraz in two aquatic invertebrate species Gammarus pulex and Hyallela azteca. Furthermore, we explored median lethal concentrations (LC50) of azoxystrobin in the presence and absence of prochloraz, the inhibition strength (IC50) of prochloraz, and its effect on the locomotory behavior of the two species. Bioaccumulation of azoxystrobin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg-1, while bioaccumulation of prochloraz was different in two species, with BAFs 57 and 110 L kg-1 in G. pulex and H. azteca, respectively. Many biotransformation products were found for both fungicides in both species of which caurine and malonyl conjugates surgically identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-hydroxycarbonyl group of azoxystrobin and imidazole ring of prochloraz. Prochloraz inhibited the CYP-catalyzed biotransformation of azoxystrobin in both species, leading to higher internal bioaccumulation factors (BAFs) approximately 5 L kg-1
and *H. azteca*, respectively. The LC₅₀ of azoxystrobin alone were 157 and 200 µg L⁻¹ in G. pulex and *H. azteca*, respectively. Prochloraz significantly decreased the LC₅₀ of azoxystrobin 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.

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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 embryos’ sensitivity’s period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among different species. However, it is not known under which conditions this 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 gas- trulation 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.

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Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the effects of pesticides. However, it is not known whether and 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 reexposed from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below the tolerable acute effects showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC₅₀ 218 µg L⁻¹) compared with non-exposed populations (mean EC₅₀ 81 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 affecting sensitive test organisms and also lower than those predicted to be safe by governmental risk assessment frameworks.

### 234 The use of anti fouling bioicides in a changing world: combined findings of nanotechnology and biocidal species.

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The use of anti fouling agents to prevent organism’s adhesion onto surfaces continues to be used worldwide. While the European Union already authorized the use of DCOIT (4.5-Dichloro-2-octyl-2H-isothiazol-3-one) bioicide, data on its toxicity to non-target organisms is still scarce. Given the advances in the encapsulation of biocides in smart-releasing systems, this work aims to access the impacts of a new anti fouling approach, DCOIT encapsulated in silica nanocounters (SiNC@DCOIT), toward the non-target species *Sarcophytom cf. glaucum*, a coral that is also a model of the cnidarian-alga symbiosis found in some marine invertebrates. Elevated seawater temperatures, as predicted by global climate change scenarios, are described as a major cause of corals reef decline. Due to DCOIT photosynthesis inhibition properties, a joint effect of these two stressors (warmer seawater and DCOIT) may occur in the ocean. Toxicity assays were performed by exposing monocolonal coral fragments (n=5) for seven days, at two different temperatures (present day conditions—26°C— and forecasted scenario for 2100—30.5°C), to 50 µg DCOIT L⁻¹ for free-DCOIT or SiNC@DCOIT and 196 µg SiNC L⁻¹ (nanocounter control). A negative control was added for each temperature. Photosynthetic parameter (Fv/Fm) was measured using a Pulse Amplitude Modulated Fluorometer (PAM), with the behavioural endpoint (40 polyps open) being scored and the biochemical parameters (both in animal and microalgae fractions) being determined by malondialdehyde content and thermal stress in a coral species. We conclude that the development of tolerance for exposed populations may increase further the effects of pesticides. However, it is not known under which conditions this 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.

### 235 Assessing interspecific variation in Imidacloprid toxicity in earthworms.

A. Robinson, Centre for Ecology & Hydrology; E. Lahive, Centre for Ecology and Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgeon, Centre for Ecology & Hydrology, Cardiff & Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgeon, Centre for Ecology & Hydrology, Cardiff.

A. Robinson¹, (alerob@ceh.ac.uk), S. Short, E. Lahive¹, P. Kille, D. Spurgeon¹ Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Wallingford OX10 8BB, UK ¹School of Biosciences, University of Cardiff, Main Building, Museum Avenue, Cardiff CF10 3AT, UK Widespread interspecific variation is seen in the sensitivity of soil invertebrates to chemical pollutants (e.g. pesticides). Since chemical risk assessments are performed on the basis of tests in a small number of reference species there is a danger of significantly underestimating the effect a toxicant may have in the environment. In order to understand these differences a robust and scientifically based ecotoxicological framework for interspecies ecotoxicological extrapolation is needed. In this study a 30 fold difference in the EC50 reproduction values of imidacloprid was observed across 5 species of earthworms (Eisenia fetida, Lumbriucus rubellus, Dendrobaena octaedra, Apporectodea calignosa and Aminthus gracilis) with A. gracilis being the most sensitive and L. rubellus the least. The role of toxicokinetics in determining interspecific variations in sensitivity is interpreted by assessing the Accumulation, Distribution, Metabolism, and Excretion (ADME) of the chemical into the body and to the neurological tissues that are the common target using radiolabelled compounds and cold chemistry. The contribution of toxicodynamic traits to variations in sensitivity was assessed through genome analysis to identify 1) the number, nature and activity of key receptor genes present, and 2) molecular docking affinities as affected by the amino acid substitutions present in different species receptor homologues. Finally, to assess how these interactions affect the key biological and physiological parameters lead to overt toxicity, we use gene expression, biochemistry and life-cycle measurements. By combining these different approaches and identifying key traits, we seek to improve interspecies extrapolation, better predict species vulnerability, and thereby improved the basis for soil species protection during chemical registration.

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

M. Santen, G. Ungherese, 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. They also serve as transport system for goods. 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 high dependent on synthetic–chemical pesticides does’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 survey in Europe, 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 analyses 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 all other 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.


https://www.greenpeace.de/sites/www.greenpeace.de/files/20121203-engl..pdf

237 Benefits of international Science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework

A. Hebert, VEOLIA Environnement Recherche et Innovation / Environment and Health; S. Rinck, Griffith University / Australian Rivers Institute; P.A. Neale, Griffith University / Centre for Environmental Research GmbH; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; F.D. Leusch, Griffith University / Australian Rivers Institute; P.A. Neale, Griffith University / School of Environment; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; M. Dingemans, 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 components bioassay response along with metabolites could include comprehensive and high-throughput monitoring systems for a wide range of water contaminants, without the use of experimental animals. Smart combinations of chemical & biological analytics can lead to reduced uncertainty in safety assessments, especially with regards to endocrine disruption, oxidative stress as other relevant primary adverse outcome pathways triggered by environmental mixtures of water micropollutants. Gathering the experts worldwide, recent large scale projects delivered several methodological advances leading to a comprehensive framework including the most promising panel of assays and expanded effect-based trigger values (EBT) for both drinking water and environmental waters (GWRC Endocrine Toolbox II, FP7 DEMAOU, FP7 Software). The GBA EVOLUTION project further innovation could contribute to strengthen the 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 proactive tools to regulate the 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 developed for the assessment 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

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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 and critical characteristics 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 achieve good quality waterbodies to safeguard chemical and ecological solutions. To be effective, action needs to be continuously developed and supplemented in order to reflect new knowledge and best available technology regarding micro-pollutants. This also includes more holistic approaches for the assessment and monitoring of chemicals. The review of the Water Framework Directive can provide a suitable window of opportunity in this regard as agreed by the European Water Directors in 2016. However, there are challenges regarding the inclusion of new approaches to a regulatory context.

239 Non-target Screening for Holistic Chemical Monitoring and Compound Discovery: Open Science, Real-time and Retroactive Approaches

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Non-target screening (NTS) with high resolution mass spectrometry (HR-MS) provides opportunities to discover new chemicals 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 NTS. Using a variety of case studies from Europe, this talk will highlight how open science activities such as MassBank.EU (https://massbank.eu), the NORMAN Suspect Exchange platform (http://www.norman-network.com/?q=node/236) and NORMAN Digital Freezing Platform (http://norman-data.eu) as well as the US EPA CompTox Chemistry Dashboard (https://comptoxt.epa.gov/dashboard/) can support NTS. 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 of as-yet-unidentified 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 that is unthinkable only a few years ago. Note: This abstract does not reflect US EPA policy.

240 Toxicological profiling of water samples with in vitro bioassays and assessment using effect-based trigger values

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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. Vesper, 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 data to evaluate risks associated with chemicals 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 transcriptomic data are available, KAMs can be used with statistical approaches, such as reverse causal 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 (WWTP) 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 previously published data about chemical-gene interactions to develop a KAM for detected chemicals at five locations near two WWTPs. 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.

Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations

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

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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. Several crop protection industry taskforces (Triazole Fungicides Focal Group, TFG; Triazole Metabolism Group, TMDG) are jointly addressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, 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 R53. 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 occurrence in groundwater. The TMDG 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 expanded 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.
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

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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 of the molecule in 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 fertiliser 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, but 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 practise. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitability, with in-depth farmer interviews to document relevant product applications and rule out use of 124T-containing fertilizer in the upstream infiltration 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 practic. Ruling out other sources is challenging, but possible with site screening and engagement with the farmers.

245 Leaching of 1,2,4-triazole through agricultural fields in Denmark

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The compound 1,2,4-triazole is a degradation product of many azole fungicides and growth regulators used in agriculture. Leaching of 1,2,4-triazole from agricultural fields has been evaluated in Denmark in the Danish Pesticide Leaching Assessment Programme (PLAP; www.pestidvarsling.dk), which comprise five agricultural scenarios for leaching risk in real-world agricultural practises. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitability, with in-depth farmer interviews to document relevant product applications and rule out use of 124T-containing fertilizer in the upstream infiltration 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 practic. Ruling out other sources is challenging, but possible with site screening and engagement with the farmers.

246 The triazole story: Differentiation between different 1,2,4-Triazole sources using a 13C stable isotope labelled azole-fungicide

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1H-1,2,4-triazole (124T) is a small and ubiquitously occurring molecule which originates from different anthropogenic sources (e.g. azole-fungicides, fertilizer additives, pharmaceuticals) but is also naturally formed. The environmental degradation pathway and footprint of 124T is complex, partly still unknown, and very difficult to correlate to individual sources. 124T is toxicologically classified as R63, so according to the EU Regulation, Directive 1107/2009, it is a ‘relevant’ metabolite in groundwater. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches are needed. A GLP terrestrial field dissipation study investigated the dynamic of 124T produced from Tebuconazole (TBZ) in the field and aimed to gain Deg/T50 data for 124T and TBZ while differentiating between different 124T sources. In the study 13C labelled TBZ (13C-TBZ) was applied to bare soils in six different locations across Europe (Spain, Italy, UK, Germany, Belgium, and Denmark). The use of non-labelled triazole fungicides or N-stabilized fertilizers could be excluded for all sites since 2013. 13C labelling allowed for the differentiation between 124T from TBZ and from other sources. Soil samples were collected at 1½ sampling times from 0 to 360 days after application, in triplicates and in additional control plots. The soil samples were analysed for residues of 13C-TBZ, unlabelled TBZ (12C-TBZ), 13C labelled 124T (13C-124T), and unlabelled 124T (12C-124T). Residues of 13C-TBZ remained in the top-soil segments. There were no detect 12C-TBZ in any of the investigated samples. 13C-124T as the degradation product of 13C-TBZ could be detected in all six trial sites in varying concentrations. For special note, 12C-124T was detected in four of the six trials, even though the use of triazole fungicides on the trial plots could be excluded for a minimum of three years before the application. At one trial site, residues of 12C-124T were detected down to a depth of 100 cm in all plots with a maximum concentration of 117.6 g/ha. The data collected in this study confirm that in many cases the origin of 124T findings is not the use of azole fungicides, but other sources. 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.

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

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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. Furthermore, TFAA is a byproduct of the biodegradation 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 contri bution is mainly due to 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 raw 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

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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 Tefan 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 14Cressidue 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 physiochemical 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 bioaccessibility. 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

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The assessment of the environmental impacts of an environmental substance is based on ready biodegradability tests, demonstrating a rapid biodegradation in most environmental media. However, when these tests are applied to poorly water-soluble substances, difficulties are encountered, often related to their limited bioavailability towards the microorganisms inducing increased variability that we have studied. An innovative strategy has therefore been established in order to improve the assessment of biodegradation and toxicity of these substances. It has compared 24 methods of improving bioavailability methods (BIM) and initiated the revision of the international standard ISO 10634.

250 Impact of temperature on micropollutants removal in an activated sludge system

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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 biodegradation systems emphasizes the need for better understanding of how such processes are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arrhenius-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 micropolllutants (69g/L) was monitored over time at five different temperatures (4–40°C range). The experimental kinetic parameters were compared to 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. In a model developed explicitly predict rate constants above 20°C, despite major risk assessment guidelines recommend Arrhenius model predictions in the 0–30°C range. 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 Arrhenius-behaviour over the 4–40°C range, the biotransformation processes may be linked to basic living cell functions as they are sensitive to temperature fluctuations. Our study highlights limitations in the applicability of Arrhenius-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

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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 prioritisations on 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 lactate, 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 intra- and inter-laboratory variation in biodegradation test outcome will also be discussed.

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 IOM - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; M. Kruse, Fraunhofer IOM - Institute for Molecular Biology and Applied Ecology; J. Hassink, BASF SE / Environmental Fate

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 the aquatic environment like direct and indirect photolysis are not addressed. Since biodegradation 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 instable compounds. Hence, beside direct photolysis in the upper water layer, 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 litre volume are filled with surface water taken from a natural lake and maintained at 20°C. The geometry of the container result in a water level of 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. 253 Poster spotlight: TU267, TU268, TU269
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 harmonization and analysis framework for 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. Niero, 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), included in the Cradle to Cradle® certification program; ii) 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 identifying the most suitable alternative from a CE perspective.

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Consistent allocation using archetypes of LCA Goal and Scope definitions
D. Schriever, ISM; G. Sonnemann, University of Bordeaux / ISM CyVi

Identifying a suitable allocation procedure is always a challenge in the modelling of the life cycle of products. This is often the case for international and multi-products that could be used in multiple life cycles due to efficient recycling. PE International recommend how to apply allocation for the production and recycling of metals [1]. 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 the most suitable allocation approach, we conducted a survey of the most common allocation procedures and scope definitions. The 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 recognized in a production phase. The laptop is modified to reflect a closed loop for recovered materials. Based on data collected by a reuse organisation, computers are often considered for self-repair by consumers. In order to increase the number of successful repairst and reduce the required time, current European policy aims to improve the repairability of products. The potential environmental benefits of reuse after repair are investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assumed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. This recycling phase is assessed through a life cycle system that are taken into consideration. We present a framework that shows how interpretation and communication of LCA results. [1] PE International, Harmonization of LCA Methodologies for Metals, Ottawa, Canada, 2014.

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Sustainability assessment of product lifetime extension through increased repair and reuse
E. Bracquene, J. Peeters, J. Duflou, KU Leuven / Department of Mechanical Engineering; W. Dewulf, KU Leuven Association/Group T / Department of Mechanical Engineering

The concept of circular economy is characterized by an economy that aims to keep products, components and materials at their highest utility and value at all times. Based on data collected by a reuse organisation, computers are often considered for self-repair by consumers. In order to increase the number of successful repairs and reduce the required time, current European policy aims to improve the repairability of products. The potential environmental benefits of reuse after repair are investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assumed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. This recycling phase is assessed through a life cycle system that are taken into consideration. We present a framework that shows how interpretation and communication of LCA results. [1] PE International, Harmonization of LCA Methodologies for Metals, Ottawa, Canada, 2014.

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Building - Rooftop Symbiosis at the next level. Improving urban agriculture through circular economy strategies
M. R. Sá, I. CTAC-UBA / Institute of Environmental Science and Technology & Department of Chemical, Biological and Environmental Engineering; A. Petit-Boix, University of Freiburg / Chair of Societal Transition and Circular Economy; G. Villalba, X. Gabarrell, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology & Department of Chemical, Biological and Environmental Engineering

Cites food supply has become an emerging problem with consequences like greenhouse gas emissions or land occupation. In this direction, new ways of producing food within the limits of cities have arisen as potential solutions. Integrated Rooftop Greenhouses (i-RTG) have the potential of a conventional greenhouse for producing vegetables, but they are located at the top of a building,
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 hydroponic 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 nutrients need to be optimized. In this sense, different literature express that half of the currently economically phosphorus 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 perlitic sachs (hydroponic 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
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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, we develop a 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 climate change or fossil resource depletion exceeding 2.54 kg CO₂ eq. or 1.58 oil eq. per kg, respectively. To the best of the authors’ knowledge, no chemical in patents or literature meets both of these threshold values. In contrast, chemical recycling is beneficial compared to energy recovery in all studied cases. The presented method enables the easy and early-stage assessment of the maximal environmental reduction of chemical recycling. The case study shows that chemical recycling should target PET waste that is currently used for energy recovery or needs to transform waste from mechanical recycling to high value-added chemicals.

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 PFOSF 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 evaluating 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 the use of these products and the update will be presented. The presentation 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 concluded 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"
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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. SUPPES SISP model include 1) characterisation of PFAS in use and for different selected consumer products 2) initial alternative selection based on matching function criteria and toxicity and exposure assessment and 3) final selection of alternatives undergoing full environmental impact and technical performance assessment for specific scenarios. The SUPPES project has demonstrated an iterative model for practical substitution where in addition to evaluating the environmental and health performance of alternatives, the technical and economical performance are also included. It is clear that distinct substitution strategies will be required for PFASs in different textile products because of the range of performance requirements. Evaluating functionality of the different products revealed that it is critical to have a chemical (alternative) product that has the required functionality, but also to measure function in new ways matching the actual requirements. Hazard assessment on chemical substitution challenges in textile applications. Srevea IVF AB / Energy and Environnment (ITM); K. Ohno-Woodall, Secretariat of the Basel, Rotterdam and Stockholm conventions UNEP, International Environment House, 11-13 Chemin des Anémones, CH 1219 Châtelaine, Geneva.
functional basis. Based on this case we were also able to further elaborate on the inclusion of the life cycle perspective in a CAA framework by identifying both 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. Levenson, University of Borás; P. Gillgward, Sweve IRA 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 substances,” 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 fluororinated polymers (SFs) 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 short perfluoroalkyl chains and their units. New properties to provide substances and oleophobic fibre modifications SFs based on long perfluoroalkyl chains were historically used on all kinds of different textiles 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 repellency properties provided by using established material 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 steep repellency surface repellency, but they are still technologically 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 sharp, pointed weapon may influence the shooter to apply 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, 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 health 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 as 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 applicable uses requires an extensive study. Case studies 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. Hansen, RWTH Aachen University Institute for Environmental Research, Aachen; H. Höfer, Staatliches Museum für Naturkunde Karlsruhe; S. Jänsch, ECT Oko toxikoziologie GmbH; S. Lesch, Senckenberg Museum of Natural History (SMNK), 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. Römbke, ECT Oko toxikoziologie GmbH; B. Scholz-Starke, RWTH Aachen University, Institute for Environmental Research / Research Institute for Environment Research; A. Toschki, Research Institute Gaiac; D.I. 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 14000 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 the pan-European level aims at integrating a) the development of (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
Diving into REACH database with Rstudio to produce input data for the USEttx model for thousands of chemicals

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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 USEttx 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 (3,250,136 test results) and human toxicity data (41,381 test results) available in the IUCLID 5.5 database (as of May 2012); data were collected at the genus level (where possible) or in mixed sets of organisms from more than one species. This 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 Rstudio program [6] where data treatments / manipulations / calculations were performed. We 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 7,000 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 30,006 End-point study reports (ESR).

268 The effect of modelling decisions on macroinvertebrate sensitivity modelling

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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 has yet to be fully tested. For this reason, we conducted this study to test the assumptions of this method in a critical manner. We start by implementing the original method, which will be used as the null method when comparing the different modelling alternatives. As input data, a toxicity, chemical classification, chemical characteristics, and a traits database are used. First, the relative sensitivity of each species to each compound is calculated. Next this relative sensitivity is averaged over all compounds belonging to the same Mode Of Action (MOA) class, resulting in a Mode Specific Sensitivity (MSS) value. Subsequently, exhaustive multiple linear regressions are made between MSS values and species traits, looking for traits which are best in explaining species sensitivity. The next step is to see the effect of different modelling decisions. As a first aspect, the effect of the used model selection criterion is studied. This is done by comparing the cross-validation error resulting from using the adjusted R² or the Akaike Information Criterion (AIC). As a second aspect, the effect of the used taxonomic level during species-trait matching is studied by comparing the adjusted R² of models resulting from species-trait matching done at family or at genus level. Third, two methods for exploiting species traits data are explored, trying to find out whether using the individual values or transformed R² 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 7,000 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 30,006 End-point study reports (ESR).

269 New approach facing new challenges in Ecotoxicology: D counter

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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 to 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 chromatic 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 with 48 h of hatching) or nauplii (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 test. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in bioassays does 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 fulfil invertebrate regulatory toxicity requirements

K.A. Connors, S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization

The OECD 202 Acid Daphnia Decline in Toxicity Test requires the use of Daphnia magna or another “suitable Daphnia species...”. 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 widespread use and acceptance in other countries. Standard acute assays conducted with C. dubia submitted to fulfill REACH dossier can only be used as supporting or weight of evidence studies and not as key studies. 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 every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in bioassays does 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.
Assessment and management of stormwater on sediment recontamination due to metal contaminants

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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 MERX-T. The samples were analyzed for a variety of metals (Cu, Pb, Cd, Ni, and THg) as well as particle-size analysis 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 and Pb are 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, while 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.

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

L. Teng, VU University Amsterdam / Animal Ecology; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

In the standard toxicity tests, metals are spiked freshly into test soils as easily soluble lead 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 d 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) was 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 and 1.72 to 2.78 and 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 (PbO), 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.

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

F. Awuah, University of Saskatchewan / Toxciology 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. Awuah1, B. Hale1 & S. Siciliano1, 1University of Saskatchewan, Toxciology Center, 2University 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 mixture rays, and five metals (Pb, Cu, Co, Ni, Zn) at one dose. The activity of the soil enzymes ammonia monoxygenases, beta-glucosidases, acid-phosphatases and arylsulphatases 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 revealed a pH-dependent 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

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

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Abstract Title: The influence 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. F. candida 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 conditions), 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%, and 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. Soils incubated 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. 2-50 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 (avoidance). When tests were performed at different moisture content 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 both F. candida and E. crypticus could avoid metal(loid)-contaminated soils, but their capacity was highly dependent on soil moisture conditions.

Manganese bioavailability in legacy contaminated soils by medieval
Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (II)

278 Profile of microplastics in water and sediments of Anantú river in Portugal
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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 environments. These microplastics (MPs) differ in 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 Anantú 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 14.3 ± 18.3 mg m⁻¹ 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 influenced 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 São João da Madeira and Aguincheira, 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 54:38:39 and 54:38:39:39, indicating that fewer particles are highly oxidized. Foams and fibers were the most abundant type in São João da Madeira, while fibers and fragments are the most abundant in Aguincheira and Estareja 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 carriers systems 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

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 slow 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: Baden-Württemberg, Bavaria, North Rhine-Westphalia, Hesse and Rhineland-Palatinate in cooperation with the University of Bayreuth. Monitoring was carried out in terms of size characterization, chemical composition and toxicity. The programme comprised microplastic monitoring in two large river basins (Rhine and Danube), including tributaries of various sizes, thereby covering a wide range of hydrological conditions and anthropogenic influences. A total of 52 measuring points distributed over 25 rivers and streams were examined for MPs near the water surface. MPs were sampled via MantaTrawl and analysed by FTIR spectroscopy. A total of 5466 (< 5mm) particles were identified as plastic particles and were characterized in terms of polymer type, size and shape. To our knowledge, the study of the five federal states in cooperation with the
University of Bayreuth represents one of the most comprehensive measuring programs in fluvial systems regarding the number of sample sites and the analytical accuracy. Experiments of the study, focusing on particle number, distribution of size classes, particle shapes and polymer types at the water surface of rivers in western and southern Germany will be presented.

280 Exploring the relation between plastic concentration and river discharge in an urban river

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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 are 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) in May, 2021 (P1 and P2) and these samples were concentrated at different discharge conditions 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 followed 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, a 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

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Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally, where their presence has been associated with wastewater treatment plants. Methods for assessing microplastic pollution. Results presented here f...
sites are located in the area surrounding the “Federico II” coal-fired power plant. The studied area included the territory of the Province of Brindisi, close to the coal-fired power plant “Federico II”, and in the territory of the Province of Lecce at about 26 km SSE of the power plant. The Lecce site was included to assess the impact of the power plant emissions at middle distances. The measuring sites are Lendinumino (LN), Cisternino (CI), Torcibiarolo (TR) and Lecce (LE). The Lecce site is part of an observation network of the Global Atmosphere Watch (GAW-WMO) program. Daily PM	extsubscript{10} samples were collected at the different sites during measurement campaigns in different seasons (summer, autumn and winter) between 2013 and 2016. Specifically, three measurement campaigns were performed simultaneously at the four sites in 2016 and the dataset was enriched with previously available data collected in 2013 and 2015 at the sites in the province of Brindisi (LN, CI, TR) and Lecce (LE) for a total of 457 daily samples. Collected samples were chemically analysed to determine 19 species: the carbonaceous components (EC and OC); the water soluble ions Cl\textsuperscript{−}, NO\textsubscript{3}\textsuperscript{−}, SO\textsubscript{4}\textsuperscript{2−}, Na\textsuperscript{+}, NH\textsubscript{4}\textsuperscript{+}, K\textsuperscript{+}, Mg\textsuperscript{2+}, Ca\textsuperscript{2+}; the elements Al, Si, Ti, V, Mn, Fe, Ni, Cu and Zn. Measured data was used for source apportionment of PM\textsubscript{10} based on a receptor-oriented model approach that integrates the results obtained using the SAPRC-75 (source apportionment program for receptor calculations). Results of these in situ measurements were used as input in the CALPUFF dispersion model. This approach allows to estimate the primary contribution of the power plant to PM\textsubscript{10} and to obtain an estimation of its contribution to secondary sulphate.

285 Air pollution toxicology: is it the right time to leave the bench for the field? A case study integrated approach

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In conclusion, the results of the present study suggest that air pollutants are associated with MN. Further studies are needed to determine the mechanisms underlying the genotoxic effects of air pollutants in children.
implementing policies of public health protection.

288 Source apportionment of PM near steel plant by electron microscopy
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Source apportionment based on bulk chemical analysis often uses advanced statistical tools for a detailed source categorization. In contrast, in this study the source apportionment is based on properties of individual particles determined by scanning electron microscopy with energy-dispersive spectrometry (SEM-EDS).

The receptor site is located near a steel plant in the Apulia Region, South Italy. A total of 5000 particles were analyzed by SEM-EDS and based on the morphology and chemical composition they have been classified into the following main groups: Aluminosilicates; Silicium reach particles; Ca-rich particles; Biological particles; Carbonaceous particles; Soot; Kish flakes; Salts of Sodium Chloride (sea salt); Calcium sulfate; Metal particles; Secondary particles; Fe reach particles (Fe mixture and Fe oxides). All particles, which could not be classified into one of these groups, were listed as other particles. The particle groups observed in the present investigation can be assigned to different emission sources. Besides the chemical composition, information on the morphology and mixing state of the particles is helpful for discrimination of industrial emissions originating from high temperature processes from a natural soil component, for both iron-rich particles as well as silicates. In the present study, the following source categories have been distinguished: soil, industrial, secondary, biological, soot, Ca-rich particles. In industrial, soil and secondary, particles of different groups are merged.

The source apportionment analysis performed with the single particle analysis let to investigate the dimensional and mass distribution of the sources in PM10-2.5, PM2.5-1, PM1 fractions, showing that the antropic sources are mainly present in the fine and ultrafine particles, while the natural sources are characterized by coarse dimension.

289 Oxidized transformation products of polycyclic aromatic hydrocarbons in secondary organic aerosol particles
A. K. Suski, Oregon State University / Environmental and Molecular Toxicology; S.L. Mason Simonich, Oregon State University / Department of Environmental and Molecular Toxicology; A. Zelenyuk, Pacific Northwest National Laboratory; K. Suski, Pacific Northwest Laboratories; D. Bell, Pacific Northwest National Laboratory

Long-range atmospheric transport of polycyclic aromatic hydrocarbons (PAHs) in fine particulate matter (PM2.5) remains a global health concern as transport models continue to fall short of accurate predictions. To improve modeling accuracy the determination of chemical speciation of PAHs within PM2.5 is necessary. Secondary organic aerosol (SOA) particles sorb PAHs during formation and transport them as a large fraction of global atmospheric PM2.5, and the presence of PAH vapor has been demonstrated to increase the mass loading of atmospheric SOA. The oxidation of four PAHs were studied in laboratory generated α-pinene SOA experiments, β-pinene (DBT), phenanthrene (PHE), pyrene (PYR), and benz(a)anthracene (BaA) were measured along with their oxidation products in freshly formed α-pinene ozonolysis SOA grown in the presence of vapor phase PAH (PSOA). Ratios of oxidized transformation products was measured and changes in those ratios was observed during the aging of the SOA, as well as after exposure to ozone. In freshly formed PSOA, the sum of measured oxidized products was found to be equal to the measured amount of parent compound in all four systems. Characterization of aged particles provides evidence of continuing chemical reactions in PHE and PYR PSOA. DBT and PHE PSOA showed evidence that ozone exposure, performed in a flow-tube reactor, results in further oxidation. Data suggests the environment inside SOA particles are complex and dynamic, and need to be further explored. Implications of the presence of oxidized PAHs in long-range transport modeling will be discussed.

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

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

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 to xenobiotics exposure in aquatic organisms. DST, GTPase and transporter, P-glycoprotein (P-gp) and multidrug resistance-associated protein (MRP) are ATP-binding cassette (ABC) transporters that confer multixenobiotic 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 molinate) 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 system in 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, these results demonstrate a key 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, IADIA CSIC Barcelona / Environmental Chemistry; B. Campos, Unilever R&D / Environmental Chemistry; B. Pina, IADIA-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 approachs 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 hydroxide gene (TRH), the rate limiting enzyme of serotonin synthesis, and others having the transporter protein gene ABCB1 mutated. Bi-allelic PAM TRH mutants lack serotonin, and show their growth rates impaired. Bi-allelic indel ABCB1 mutants had lower transcription activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoroxetine 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 ivermectin and its total or partial knockout dramatically increased its toxicity. These results provide the first evidence over for 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.)

294 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, RisigewayEco

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 often populations were impacted by pesticides. 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 the most sensitive to the test insecticide. The mid-larvae instars was less impacted, with the late 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.

295 Poster spotlight: TU108, TU109, TU110

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

296 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. Krauss, 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. Schön, Helmholtz Centre for Environmental Research / Cell Toxicology; B. 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 tens of thousands of chemicals among them many non-regulated compounds and 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 Courmarin 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 amine 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.

297 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 exposure (receptors) is greatest when it coincides with the lag time (delay) in 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 that carry-over toxicity amongst chemicals acting on different targets and when exposure is severe days apart. It is therefore not only the dose that makes the poison but also the exposure sequence.

298 How to deal with mixtures of pollutants in water resource management? R. Altenburger, 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 composition, 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 Exposure to mixtures. We will present a novel concept to identify critical mixtures that are good mixtures for our overall objectives and that 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 emergents from different contaminant contributions and their effects 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.

299 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 poly-chlorinated 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
PBDE in fish. We then make an attempt to expand the assessment by integration across these pollutant groups. While the definition of Quality Standards for specific pollutant groups is a step in the right direction, our analysis shows that more efforts are needed to protect humans from possible combination effects across pollutant groups. Such efforts are currently hampered by data gaps concerning common toxicities likely to arise in humans.

300 An Advanced Methodological Framework for the Identification of Priority Pollutants and Priority Mixtures of Pollutants in European Freshwaters
M. Faust, Backhaus & Backhaus Environmental Consulting; R. Altenburger, UBC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; T. Bock, University of Gothenburg / Department of Biological and Environmental Sciences; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; V. Dulio, INERIS; J. van Gils, DELTAES; A. Ginebre, CSIC - Spanish National Research Council / Environmental Chemistry; A. Kortenkamp, Brunel University London; J. Munthe, JVL, Swedish Environmental Research Institute Ltd; J. Slobodnik, Environmental Institute; K. Tolnai, Hungarian Academy of Sciences / Environmental Toxicology and Risk Assessment; van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health

We present a proposal for an advanced methodological framework for identifying priority pollutants and priority mixtures of pollutants in European freshwaters. The proposal was developed by the EU project SOLUTIONS. It aims to tackle major shortcomings of current prioritisation procedures under the EU Water Framework Directive (WFD). However, although data gaps may provide an attractive conclusion, they may be under-represented by the prioritised for further research. A conclusive risk assessment cannot be met. Significant risks from so-called emerging pollutants may remain undetected. The WFD does not include an effective mechanism to close such knowledge gaps. The introduction of a watch-list mechanism for up to 10 substances provided a minor improvement but no fundamental change to this situation. (ii) Individual pollutants are assessed as if they would occur in isolation, largely ignoring the fact that they are part of complex multi-constituent mixtures. Environmental quality standards that have been established for single priority pollutants may not be sufficiently protective against mixture effects. Regulatory approaches for effectively tackling the problem are missing. The advanced framework integrates all available lines of evidence (LOE) on significant risks. This includes evidence from biological monitoring (field observations on so-called biological quality elements), (ii) effect-based monitoring (in vitro or in vivo testing in the lab or onsite), (iii) chemical monitoring in combination with so-called component-based mixture risk assessment approaches, (iv) integrated modelling of co-exposure and resulting mixture risks. Where one or more lines of evidence identify groups of pollutants presenting a significant risk, those pollutants be prioritised for risk reduction measures. Where appropriate, such groups may be reduced to few mixture components or even single component which can be demonstrated to explain most of the overall risk, so-called drivers of mixture risks. Wherever conclusive evidence on significant risks and needs for risk reduction cannot be reached because all possible LOEs are somehow blocked by significant data or knowledge gaps, mixture components of potential concern are not left unnoticed but they are prioritised for further research and testing. Some elements of the advanced methodological framework may be readily applicable under the existing WFD. Full implementation, however, requires changes in the legal text, as detailed in Brack et al. 2017 (Sci Total Environ 576:720-737).

301 A diagnostic toolbox for ecological effects of pollutant mixtures: a case study application using in situ experiments with microbial communities
T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; A. Arthensius, University of Gothenburg / Biological and Environmental Sciences; R. Behra, Eawag / Department of Environmental Toxicology; T. Seiler, Eawag / Department of Environmental Toxicology; P. van den Brink, Alterra and Wageningen University; B. Deutschmann, RWTH Aachen University / Department of Ecosystem Analysis ESA; N. Corol, University of Gothenburg / Department of Biological and Environmental Sciences; A. Fock, Alterra Wageningen University / Ecosystem Analysis; A. Korting, University of Technology / Department of Environmental Chemistry; H. Hollert, 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 Maximum 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 MAC-EQS 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 fles and abundance/development in invertebrates. The results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is inappropriate.

302 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-EPEL / 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 Maximum Allowable Concentration that should never be exceeded and the AA-EQS defines a concentration that should never be exceeded by the Annual Average concentration. While the MAC-EQS 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 fles and abundance/development in invertebrates. The results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is inappropriate.
substances, the number of AA-EQSs and MAC-EQSs 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, 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 reduced AFs 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 amphibians or invertebrates, and a lack of information 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

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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

One of the tools used by regulatory jurisdictions to deliver environmental protection is Water Quality Guidelines (WQGs) or Environmental Quality Standards. These are thresholds expressed as a chemical concentration, with an associated summary statistic (e.g. maximum) and period (e.g. “annual average”). These thresholds are used around the world for a number of purposes including to assess water quality and to set discharge limits and ECQs. What research efforts have been undertaken to significantly evolve the way we derive WQGs? To what extent have the outcomes of this research been adopted in formal derivation methods? Why has the fundamental SSD approach not changed markedly over the past 20 years despite various proposed improvements? Do we need to move to a new generation of WQB derivation approaches and, if so, what are the aspects that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?

306 A Call for Greater International Collaboration in Developing Environmental Quality Benchmarks: Many Hands Make Lighter Work!

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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 WQBs 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 “marine” and acceptable for many regulators 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.

307 Bringing water quality benchmark derivation approaches into the 21st century

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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 that has no adverse effects on a defined percentage (e.g. 5%) of species. Although various forms exist in the specifications 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. bimodality). 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 variety of questions associated with WQB derivations: what are the current limitations? What research efforts have been undertaken to significantly evolve the way we derive WQBs? To what extent have the outcomes of this research been adopted in formal derivation methods? Why has the fundamental SSD approach not changed markedly over the past 20 years despite various proposed improvements? Do we need to move to a new generation of WQB derivation approaches and, if so, what are the aspects that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?
Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring

308 The impact of anthropogenic activities on bacterial and viral diversity in the Eastern Mediterranean Sea

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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 “National 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 Patraiko Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cd, Cu and Pb. The highest concentrations of NO3, NO2, NH4, PO4, 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, Simboura N, Rousselaki E, Tsapakis M, Pagou K, Drakopoulos P, Assimakopoulos G, Koutoyiannis 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. Kufaflou, Macquarie University / Evolution and Ecology Research Centre; P. Steinberg, University of New South Wales / Centre of Marine BioInnovation; 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.K. Sim, University of New South Wales; T. Lachnit, University of Kiel; S. Swarp, 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 channels. Sediment samples were collected monthly during base rainfall (< 5mm/day) for 4 months from 3 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 phosphorus. Sediment cores were also collected to monitor 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-Doval, F. Romero, V. Acuña, S. Sabater, ICRA Catalan Institute for Water Research

Climate change will affect agriculture practices and productivity because increased intensity and frequency of drought events lead to stress and changes in phenology, 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 degree of experimental conditions). 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 these 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 (< 0.001 Dunnet’s test) while diversity was significantly higher in D, TD and TP conditions (< 0.001 Dunnet’s test). Taking into account per community metric, the oxidative stress caused by the pesticide mixture has 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

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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 polysaturated fatty acids (PUFA) that are needed for organisms at higher trophic levels in rivers and 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 testing 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 rivers 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
streams might be toxic for periphyton (i.e. inhibiting the photosynthetic activity), being herbicides the driving chemical stressors. Results from the field, indicate that when the levels of pesticide pollution are low and co-occur with high levels of nutrients pollution, nutrients migh mask pesticides effects on periphyton quantity and quality because compensatory effects from nutrients.

312 Estrone and triclosan mixture alters soil metagenomics during degradatlon D.L. Carr, Texas Tech University / Biological Sciences; E. Osuji, Texas Tech University / Biological Science Wastewater derived from domestic use commonly contains mixture of pharmaceutical and personal product (PPCP), but its persistence and accumulation in the soil and the consequences for soil microbial community processes are poorly understood. Estrone and triclosan are two common PPCPs of domestic wastewater. Soil microbial communities degrade a variety of PPCPs however; most studies have only addressed single compound designs neglecting the reality of their co-occurrence in nature. In this study, we examined the interaction between estrone and triclosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, triclosan, and a 1:1 mixture of estrone: triclosan, and incubated for 90 days in the dark at 27°C. We examined soil microbial function dynamics using commercial Biolog EcoPlates™. Microbial degradation rates were compared over the 90 days’ incubation period using high performance liquid chromatography. Metagenomic analysis by 16S rRNA was used to determine changes in microbial community over time. There was significant increase in substrate activity and substrate richness in all treatments. Each microbial community utilized different carbon substrates by day 90 whereas they had exhibited similar substrate utilization at day 0. Estrone and triclosan as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (triclosan). The rate of degradation of the binary estrone:triclosan mixture was the same as the individual compounds. There was a decrease in species diversity between control at day 0 and all other treatments at day 90 with establishment of unique OTUs in each treatment group at day 90. Metagenomic analyses indicate distinct communities by treatment 90 days after exposure even though Bacillus sp. was dominant in all the 90 day treatments. Soil microbial communities are adept at degrading estrone and triclosan in this soil whether occurring singly or as a binary mixture thus preventing accumulation in soil and subsequent contamination of ground water.

313 Poster spotlight: TU014, TU015, TU016

Integrating life cycle approaches towards a sustainable circular economy (II)

314 Region-specific life cycle inventories for tailings disposal in ecoinvent v3 D.A. Turner, EMPA / Technology and Society Lab; G. Doka, Doka Life Cycle Assessments; A. Haarman, EMPA Technology & Society Lab / Technology & Society Lab; R. Hirschier, EMPA / Technology and Society Lab Tailings, a waste material produced during mineral concentration (beneficiation), often contain significant quantities of mobile toxic metals and are typically produced in large quantities. To manage these wastes, tailings are commonly stored behind dammed impoundments, known as “tailings ponds”. These ponds pose a significant long-term pollution risk as metals may leach out into the surrounding environment, potentially over very long timeframes. The management of tailings therefore represents an important environmental burden for primary metal production. To help life cycle assessment (LCA) practitioners quantify this important environmental burden, the ecoinvent database contains – since 2009 and the release of version 2.1 – a global average life cycle inventory (LCI) dataset for sulphidic tailings disposal, developed using a dedicated tailings emissions model. However, the dataset was intended only to serve as a first generic estimate and is based on highly aggregated data that attributes an identical burden to each kilogram of waste, regardless of its composition. Given their relevance to the overall impacts of primary metals production, access to more detailed, region-specific LCI data on tailings disposal is crucial for a more comprehensive and adequate integration of primary metals in LCA studies. Here, we present an extended model for assessing the long-term emissions from tailings disposal. The model can heed a specific tailings composition and local climate data, allowing for the creation of site- specific emissions factors based on an extensive literature survey. Data on tailings compositions and leachate concentrations from different mine sites worldwide, the model was used to develop new country- and region-specific datasets for tailings disposal from a range of ore types, which will contribute to improving the quality and hence reducing uncertainties in LCA studies worldwide. Our presentation will give an overview of the extended model and related datasets, which will be integrated in a later version of ecoinvent. We will also highlight its improvements compared to the previous model by presenting the results of an LCA case study of region-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.

315 Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction Lucrezia D’Angelo, 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 the context of scarce resources 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, as 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 economic function is not economi...
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, a country term 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 decline, is offset by the extension of the tax to all goods and services and by the possibility to gradually re-increase the UVAT 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 in DaVAT specific impact assessment (e.g. elaborate charge 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.

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Towards global guidance on LCIA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force T. Sonderregger, 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. Cimpl, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, treeze 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; C. Nordheijr, Monash University; D. Schrijvers, University of Antwerp; 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 great detail in impact assessment, comparing charge assessment (e.g. with standard methods), with other approaches. The assessment of impacts resulting from resource use on resource availability is still controversial – even though a wide range of methods and models are available. Therefore, this task force – comprising 48 experts from different fields and working under the umbrella of the UN Environment Life Cycle Initiative – focuses on methods assessing these impacts and works towards consensus guidance for method users and developers on what method type is best suited depending on the goal and scope of a particular LCA study. In a comprehensive literature review, more than 20 methods assessing impacts of resource use in LC($)/a have been identified. These methods have been clustered into four categories: methods assessing depletion of stocks, methods assessing “future efforts” resulting from ore grade decline as an (assumed) consequence of current extraction, methods using thermodynamic accounting (exergy and energy approaches), and methods assessing supply risk of raw materials based on socio-economic aspects (like country concentration, political stability, etc.). Within the four clusters of methods, key axioms and methodological choices, like the resource stocks used in depletion methods, the reference environment used in exergy methods, or the socioeconomic aspects considered in methods addressing supply risk are discussed. Furthermore, methods are evaluated based on a comprehensive evaluation scheme developed within the Life Cycle Initiative that has been customized to the primary mineral resource context in an iterative process in the task force. The overall aim is to provide clear guidance on best practice for each method type. Furthermore, the review process includes a debate about what the treaty will add (introduced into LCIA method should be and how problems related to resource use (provisioning capacity, availability for future generations, etc.) can best be assessed. Especially supply risk methods cover perspectives beyond “environmental” impacts and the task force keeps discussing how to map these methods in the framework of LCIA or how to use them complementary to “traditional” LCA.

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Poster spotlight: TU214, TU215, TU237

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

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Silica coating for the control of nano-reactivity S. Orteliti, CNR ISTECC; M. Blosi, CNR; D. Gardini, CNR ISTECC; A. Costa, CNR Nano-titanium dioxide (TiO$_2$) 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 toxicants 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 a technique for control two recognised toxicity drivers for nano TiO$_2$ 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 zeta potential), output parameters (e.g. release of Ag$^{+}$) and performances. We first demonstrated that both at colloidal and dried state a matrix of SiO$_2$ surrounding TiO$_2$ 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 (reduction) of 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.

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Framework for the optimal design of sustainable chemical processes A. Gonzalez Garay, R. Calvo-Serrano, G. Guillon Gosalbez, 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. This methodology is used to evaluate the potential for process intensification and downstream purification of a methanol production process. The processing of methanol from CO$_2$ and hydrogen.
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 Ven, Institute for Environmental Studies (IVM) VU University Amsterdam / Chemistry and Biology; A. Hanning, Swerea IVF AB; S. Schellengerben, Stockholm University / Department of Applied Environmental Science (ITM); J. de Boer, Vrije Universiteit 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 perfluoralkyl chains have the ability to repel liquids of a wide range of polarities (e.g. water and dirt resistant 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

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Plastic packaging is increasingly used globally, causing raising concerns for the environment and human health from littering, release of microplastic and leakage of hazardous chemicals. Specifically, chemicals may migrate into foods or the environment and human health from littering, release of microplastic and leakage of e.g. polymers and stabilizers. We ranked the substances in 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 release of chemicals from 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.

325 A Safe by Design framework to support the development of sustainable nano-enabled products for the restoration of works of art

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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. Thus, 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 support 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 bioassays for acute aquatic toxicity, 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 Apiculture

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 the summer forage areas for a honey crop. The areas of conflict for bees in agriculture end with the commercial beekeepers migrating from one crop to another to pollinate the nation’s food supply. 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 degradation, or bee health issues, for both small scale and industrial beekeepers, pest and disease management for 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. Involving 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 by pollinating 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

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In recent years, neonicotinoids 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 basis 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 qualified context and simultaneously 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

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

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the greater diversity of native stingless bees of the world and makes intensive use of pesticides. Thus, forager workers may collect pollen and nectar contaminated and, subsequently, to offer the resources to the brood. Studies on larval phase focus on Apis mellifera, since for this species the rearing method is already standardized by the OECD®. However, while in A. mellifera the larval food is progressively offered to the brood, in stingless bees the food consists of mass deposition. This scenario requires the development of techniques which enable to evaluate the exposure of native bees during larval phase to pesticides, and may be used for public authorities responsible for environmental safety for studies on risk assessments. Melipona scutellaris is an interesting species to be used as test organism for risk assessment, since, besides comprising the native Brazilian fauna, species from the same genus are recognized as effective pollinator of important crops as eggplant, tomato and sweet pepper. Thus, the present study aimed to propose an experimental larval rearing method of M. scutellaris. We extracted the larval food from 20 brood cells per non-parental colony (n = 3), for estimating the amount of food consumed by larvae. Before the experiments, the acrylic plates with the food cells were placed in a Petri dish and covered with water to keep the humidity around 95% within the Petri dishes during the first five days of rearing. Each artificial cell received 130μl of larval food and, afterwards, 24-hour-old larvae were placed in the food. Then, the plates were kept in an incubator at 30°C and 75% of relative humidity. After the total consumption of the food, the humidity within the Petri dishes was reduced to 75%, adding NaCl This technique was carried out five times sequentially, evaluating parameters as defecation rate, pupation, emergence, and mortality and morphometry of newly emerged workers. For the morphometric analysis we also evaluated newly emerged work from natural brood combs. The survival rates increased gradually according to
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?

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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 2005 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

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Building materials have important contribution to the chemical exposures 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 product that is cumulatively taken in by the users. Based on the building materials Phoros 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 mainly determined by Dm (diffusion coefficient in building material) and Kma (material-air partition coefficient). Two simple emission models were developed for two types of behaviors: D-limited and K-limited. Use-phase exposures by inhalation, dermal contact, gaseous dermal uptake and dust ingestions were calculated using the PiF metric. Results showed that for SVOCs, the total PiF can be dominated by any of the four exposure pathways. Generally, the chemical-product combinations with low total PiFs are dominated by dust ingestion exposures, while the ones with high total PiFs are dominated by dermal contact exposures. For VOCs, Inhalation PiF always dominates the total PiF. Generally, the PiFs of VOCs are similar between 50 days and 15 years, but the daily intake doses during 50 days are much higher than those during the entire 15-year use phase. In contrast, for SVOCs, the emissions and PiFs gradually increase when the duration of use is extended from 50 days to 15 years, but the daily intake doses remain similar over time. The total intake dose, which combine the total PiFs and chemical content in building product, can range from 100 to 10^8 µg/kg-d for children. This study demonstrates the approach of high-throughput screening of use-phase exposures for chemicals in building products, which can be further integrated into factorization characterizations and help improve LCA and Chemical Alternatives Assessment (CAA) of consumer products.

OPEs - Where do they come from, where do they go? A case study from Toronto, Canada

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Organophosphate Esters (OPEs) are used in a wide range of consumer products and building materials resulting in their ubiquitous presence in the indoor and outdoor environment. Concentrations of OPEs in indoor air can be relatively high, in the range of 10^6 ng/m^3 in air. Concentrations are also relatively high in urban media (e.g., low µg/L levels in urban surface waters) and OPEs are commonly found in remote Arctic air. We hypothesize that elevated levels of OPEs in the indoor environment are a source to the outdoor urban environment and then to surrounding regions. To test this hypothesis, we estimated emissions of OPEs to indoor air followed by release to outdoor air, and then compared these “bottom-up” emission estimates to “top-down” estimated aggregate emissions to outdoor urban air. We used the approach of “inverse modelling”, whereby emissions are back-calculated from measured air concentration levels. "Bottom up" emissions were estimated using the Multimedia Indoor Model that has been used to calculate emissions of PBDEs and PCBs to indoor air, based on indoor air concentrations measured in a study of 51 homes in Ontario, Canada. “Top-down” emissions were calculated using the Multimedia Urban Model based on measured Toronto outdoor air concentrations, main receptors for these molecules. Pharmaceuticals can be related to the TPMP and TPhP, 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, or through direct emissions of OPEs from insulation. 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 outdoor concentrations. Outdoor rate 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.

335 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 sources of these molecules. Pharmaceuticals can be related to the TPMP and TPhP, 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, or through direct emissions of OPEs from insulation. 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 outdoor concentrations. Outdoor rate 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.

336 Past vs. recent emissions of PCBs from the city of Brescia (Italy): coupling monitoring data with a multimedia fate model to investigate PCB regional fate

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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 accumulate in e-waste contaminated soils. 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 unveil dependence of the relative contribution of far- and near-field routes on contamination 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 process. The 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 Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

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- and near-field routes on 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 routes become more 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. Wenger, 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 Europe. The probabilistic 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 emissions to the environment. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-specific 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 enables to pin-point the principal plastic emissions 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 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 Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

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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 worms’ 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 nanoparticle mobility and accumulation. Results indicate that pristine nanoparticles and those contaminated with polycyclic aromatic hydrocarbons (PAHs) and aromatic hydrocarbons (AHs) are transported both in waterborne and dietary exposures and from dietary uptake of a nanoplastic associated algal food source, with carboxylated and amminated 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 (CFA) and immune response (phenoloxidase). Exposures 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 phenoloxidase). 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. Schrank, 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 desorb from the polymer matrix. With our transcriptionome analysis, which was conducted via the use of a microarray, we showed that Daphnia magna 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 regulations in a total of 19 genes (15 up-regulated and 4 down-regulated) related to stress responses (e.g. increased mortality and reduced growth) and the associated ecosystem processes (reduced 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.

343 Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food web
E.L. Fernandes, University of Koblenz Landau; M. Bundsche, 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 aquatic ecosystem processes. Some pollutants such as endocrine disrupting 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. Therefore, 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 meromictic 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 rates of decomposers and leaf decomposition. In contaminated microcosms compared to the control. Furthermore, decomposer’s biomass and length decreased in the contaminated but not in the control microcosms. Predators hunting decomposers from contaminated microcosms decreased in body size compared to the control. Systemic insecticides in plant materials can be a relevant source of exposure for decomposers with consequences for their population dynamics (e.g. increased mortality and reduced growth) and the associated ecosystem processes (reduced 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
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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 bioaccumulation and thus ecotoxicological risk. The core of the foodweb model is a bioconcentration model for neutral and ionisable organic compounds (Arnot & 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 all catchments. 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.

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

347 Influence of an agriculture-associated toxicity gradient on a riparian predator-prey relationship in Romania
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Riparian ecosystems in Romania are affected by a variety of threats (runoff from agricultural fields and adjacent forest areas) and by a complex network of vertebrate and invertebrate predators (e.g., spiders, birds, fish). The influence of agricultural land use related stressors including pesticides on riparian areas around Cluj-Napoca, Romania. To investigate the spiders’ diet, aquatic and terrestrial predator organisms were caught. We collected the orbweb Tetragenatha sp. and the ground-dwelling spider Pardosa sp. to analyse their stable carbon and nitrogen signals. Nutrient concentrations in the stream were slightly positively associated with the proportion of aquatic prey of Pardosa sp. This may be explained by nutrients in the streams increasing productivity of primary producers and resulting in a larger biomass of emerging insects. This toxicity gradient was negatively related to the number of individuals of spiders and the number of spider species. Although we found clear differences in the proportion of consumed aquatic prey of spiders, the proportion of it was not related to the toxicity gradient. Thus, potential effects of pesticides in the aquatic system did not affect the proportion of consumed aquatic prey organisms of riparian spiders. We found less individuals of Tetragenatha sp. when they consumed more aquatic prey. This might be due to an accumulation of toxicants in the spiders or a higher competition between the species due to resource shortage. Riparian spiders can be affected directly by agricultural land use but also indirectly via prey consumption. Changes in riparian spider communities and their diets are presumably driven by multiple stressors.

348 Migration effects on pollutants in eggs of Arctic-breeding geese
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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 in different locations) was collected at different sites along the geese’s flyway. Residgists 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 perfluoralkyl substances (PFASs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be directly related to POPs, but was related to POPs by the composition of eggs and POPs by the environmental conditions. Stable isotope and POPs in eggs were significantly different per subcatchment. They also depend on trophic position in a species due to an accumulation of toxicants in the spiders or a higher competition between the species due to resource shortage. 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 estimate 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 36.44, indicating that PFCs are biomagnifying in terrestrial ecosystems. To better understand the bioaccumulation behaviour of chemicals in terrestrial food-web, 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 hawks, 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 36.44, indicating that PFCs are biomagnifying in this terrestrial system. Overall, these terrestrial TMF values for legacy POPs were comparable to or higher than TMF values determined for several aquatic systems, and the terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling

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Toxicokinetic-toxidynamic models as new tools for environmental risk assessment

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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 (LC₅₀ or EC₅₀) 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 scenarios, for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxidynamic (TKE/T) models is suggested, because TK/T models describe the effects of a substance by integrating the dynamics of exposure [1]. Indeed, TK/T 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 TK/T 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 τ. 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 TK/T models are still not used. There are many data that allow us to use TK/T models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TK/T models would be of great value. That is the aim of the R package ‘morph’ in its new version 3.0.0. [2]. In this presentation, we will give an overview of TK/T models with a focus on the General Unified Threshold model for Survival (GUTS), [3]. Handling GUTS models in R will be then illustrated with one example dataset. Finally, the added-value of TK/T models for ERA will be discussed based on a number of different datasets.

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

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Nano-copper formulations have been studied for harming pollinators and non-target species, the amphipod *Gammarus pulex*, which indicates that copper and ionic copper are similar for this amphipod, which indicates that nano-copper at different development stages

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

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Assessing effects of a contamination on populations requires getting data on the whole life cycle and accounting for differences of 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 replicates for each treatment; new-born individuals (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-toxidynamic (TK/T) model to account for the growth (and differences between development stages) coupled with a DEB-based toxidynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 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

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Advantages of nano-based copper formulations. The no observable sublethal concentration (NOSLC) is an agrochemicals regulatory endpoint that is used to guide the development and marketing of new nano-formulations. The NOSLC is the concentration at which a sublethal endpoints are observed, and is usually defined as the concentration exhibiting a statistically significant effect on a key biomarker. However, the NOSLC does not provide information on the biological relevance of the observed effects, and is not always a good predictor of the potential ecological and human health impacts of nanomaterials. Therefore, it is important to develop new models that can predict the ecological and human health impacts of nano-formulations based on sublethal endpoints. The model used in this study is the Dose Response (DR) model, which is a widely used model in toxicology and risk assessment. The DR model can be used to predict the NOSLC, and it is also used to predict the effects of a substance on a biological endpoint at different exposure concentrations. The DR model is based on the assumption that the response of a biological endpoint is a nonlinear function of the exposure concentration. The DR model is fit to the experimental data, and the NOSLC is determined as the exposure concentration that results in a statistically significant effect on the biological endpoint. The DR model is a useful tool for predicting the ecological and human health impacts of nano-formulations, and it can be used to inform the development and marketing of new nano-formulations.
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 hypothalamus-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 oocyte maturation), fluoxetine (SSRI pharmaceutical largely negated in our in vitro assays) and tributyltin (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 was 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 tributyltin exposure, which caused regression of ovarian 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 atritic / 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

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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 effort has been recently been made in developing kinetic models for predicting metal accumulation in fish-parasite systems. Our present model allows for investigating the relationship between the accumulation in the whole fish and in the anacanthocephalan, but does not include the mechanisms how metals are accumulated in parasites.

Physiologically based pharmacokinetic (PBPK) model has been used for simulating the physiologically specific accumulation of pollutants. However, the capability 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 anacanthocephalan Pomphorhynchus tereticollis. The anacanthocephalan 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 Se absorption 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 anacanthocephalan. 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

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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 approaches are truly “end-of-pipe” approaches 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 accurate 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 changes in the risk-based monitoring results, lended 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

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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 developed to allow linkage between chemical and biological monitoring results, based on by 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 connect 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 research programmes SOLVE and SOLUTIONS project, in which the approaches are applied to link exposure dynamics of a number of chemical compounds to parsimonious individual-based population models. The EFFECTS-EU model provides exposure concentration results at the level of subcatchments, that is at a scale of tenths 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 parts 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

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SETAC Europe 28th Annual Meeting Abstract Book
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. Snow, who famously provided a solution to a cholera outbreak in Soho, London, 1854, by epidemiological reasoning. So, this paper presents a set of contemporary eco-epidemiological results, the recognition of ecological impacts in support of 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 criteria such as the European 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 prognoses, to support the EU project MARS (Mixing Aquatic pollution and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals). We present specifically a body of evidence for the wide-spread occurrence of chemical mixture impacts in current water systems at the continental and national scale (Netherlands), corroborating recent findings of this kind based on chemical risk.

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Unravelling the cocktail of stress: toxics and other stressors impacting on the ecological status of Europe’s rivers

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Water management requires solid understanding of how multiple stressors affect ecosystem status and support the EU project MARS (Mixing Aquatic ecosystems and water resources under multiple 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 multi-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.

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

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Chemicals of emerging concern (CECs) in the water cycle have been the focus of research in recent years. E.g. the use of currently used additives such as pharmaceuticals, flame retardants or nanomaterials but may also introduce new substances with potential consequences for chemical use and releases: public health, food production, urbanization and technologies. With these further developments and the resulting introduction of new substances from new sources, an adaptation of current regulatory frameworks is required. However, to prepare for a future with unknown scenarios for use and emissions of potential chemical pollutants is naturally difficult but a general approach can be developed and adopted to prepare for a future where environmental pollution by chemicals is avoided or minimised. This general approach should build upon a few basic principles: (1) The solutions-focused approach: where the same attention is given to 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 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 globalised and the transport of chemicals is transboundary – both via the atmosphere and via global trade.

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

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Towards a systematic approach for the assessment of multiple stressors: Making Aquatic Ecosystems Great Again (MAEGA)

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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. Lauen, University of New South Wales; M. Mayer-Pinto, University of New South Wales / Evolution and Ecology Research Centre School of Biological Earth and Environmental Sciences; W. Monk, Environment and Climate Change Canada; A. O’Brin, Alterra, Wageningen UR / Aquatic Ecology and Water Quality Management Group; J. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group; V. Vermeiren, ECOTOC Eawag - Aquatic Ecotox Centre Eawag; J. Vogler, B. Beck, Eawag Swiss Federal Institute of Aquatic Science and Technology; J. Hollander, Eawag / Environmental Chemistry; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group; b) Altered ecosystems. 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 data and field observations. 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 / Agricultural Research (Alterra); R. Schafer, University Koblenz Landau / Institute for Environmental Sciences; A. Bush, University of New Brunswick / Environment Canada; D. Lazen, 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. 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 depletion) and 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 monitoring data to assess the validity/predictive power of the model. The dataset will demonstrate that the framework provides a useful conceptual template to assess and predict multiple stressor impacts as well as to unravel research gaps.

364 The combined effects of nutrients and thiacloprid on macrofauna invertebrate population and community responses H. Barmentlo, Leiden University; M. Schrama, CML Leiden University / Conservation Biology; K.J. Musters, Leiden University / Institute of Environmental Sciences; P.M. Van Bodegom, CML Leiden University / Institute of Environmental Science CML; G. de Snoo, Leiden University / Institute of Environmental Sciences; M.G. Vijver, CML Leiden University / Conservation Biology

Ditches are commonly used to control for fluctuating groundwater tables in agricultural landscapes. They provide a strong linkage between agricultural fields and adjacent water bodies as they are a common sink for agricultural chemicals such as neonicotinoid insecticides and fertilizers. As these agrochemicals are bound to co-contaminate the ditches, we aimed to study their combined effects on invertebrate population and community responses. To this end, we exposed caged organisms and naturally assembled invertebrate communities to environmentally realistic thiacloprid and nutrient concentrations at the Living Lab facility. The Living Lab facility consists of 36 naturally colonized ditches of 25 cm depth in which experiments can be conducted outdoors. We found that the overall abundance of invertebrates increased in the presence of thiacloprid and nutrients. This effect was not observed in ditches which received thiacloprid and nutrient application. Consequently, we found that the importance of nutrient enrichment (and the resulting increase in primary production) for coping with thiacloprid induced toxicity. This might explain the difficulties as often faced when extrapolating lab to field data and the other way around.

365 Macroinvertebrate communities across a gradient of multiple stressors from agricultural land use in Romanian streams V.C. Schneider, M. Link, S. Kanz, E. Stoeva, University of Koblenz Landau; B. Vedrines, Eawag - Aquatic Ecotox Centre Eawag; K.P. Batters, M. Cimpean, Babes-Bolyai University; E. Vermeissens, ECOTOC Centre Eawag-EPEL / Aquatic Ecotoxicology; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; J. Hollander, Eawag / Environmental Chemistry; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences. Pesticides from agricultural usage are one of the major drivers of biodiversity loss in freshwater ecosystems. Their entry pathways are mainly related to pesticide use in agriculture. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in Eastern Europe (Romania), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture relying largely on animal labour (horses, ploughs). We assessed that, in contrast, pesticides, except for thiacloprid toxicity, excessive nutrient and sediment input would be unrelated to agricultural intensity. Consequently, this would allow distinguishing effects from pesticides and those other stressors. We analysed the relationships between pesticide toxicity and other agricultural stressors. Additionally, we analysed combined and individual effects of these variables on the biodiversity, as well as on the composition of stream macroinvertebrate communities. We found that pesticide concentrations were investigated using two different passive sampling methods. Firstly, we used styrene-divinylbenzene (SDB) disks to sample hydrophilic compounds, which can enter the concentration of approximate time-weighted pesticide concentrations in streams during heavy rainfall events. Secondly, we used polyethylene film sheets for the detection of lipophilic pyrethroids and organophosphates. The toxicity of the 88 detected pesticides was assessed using the sum toxic unit (sumTU). Stream macroinvertebrate communities were sampled twice, using a quantitative multi-habitat-sampling. This allowed the analysis of the relationships between the community composition and diversity with a gradient of pesticide toxicity in interaction with additional agricultural stressors. The toxicity gradient originated from pesticides and nutrients (NH₄⁺) showed no relationship to the intensity of agriculture expressed as the average size of the adjacent fields. This indicates that pesticides and nutrients co-occur independently of agricultural intensity. How and to which extent, in terms of effect size, the communities are affected by the pesticide gradient and the additional presence of other stressors originating from agricultural land use will be presented during the conference.

366 Daily temperature variation determines the toxicity of a pesticide mixture V. Delnia, T.T. Tran, L. Janssens, KU Leuven / Biology; R. Stoks, University of Leuven / Department of Aquatic Ecology and Water Quality Management. Synergistic interactions between pesticides in mixtures and between pesticides and warming may improve the efficacy of vector control. Particularly, synergistic interactions between biocides and chemical pesticides would be promising as these could potentially result in the combination of efficacy of control, slowdown of resistance build-up and lower ecological damage. One understudied aspect of global warming is the increase in daily temperature variation (DTV). While DTV may increase the toxicity of chemical pesticides, it is unknown whether it also interacts synergistically with biocides, and magnifies the toxicity of pesticide mixtures. We tested whether DTV influences the toxicity of pesticides with a
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 assessed effects on larval population growth rate (r) and its key components. 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 temperature sensitivity of the Growth rate. 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.

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Warming and daily temperature fluctuations make the pesticide chlorpyrifos more toxic in Ischnura elegans damselflies
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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 behavior of the plant effects on enzymes and subcellular effects (growth rate). Notably, the synergistic effect of DTF on pesticide sensitivity was higher at the high temperature. Our results highlight that incorporating higher mean temperatures and especially DTFs in ecotox testing will increase the realism of the risk assessment of pesticides under global warming.

PBT/vPvB & P&MP/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (I)

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RPLC-HELPIC and SFC coupled with Mass Spectrometry: Polarity Extended Screening of organic molecules in the aqueous environment
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Trace organic compounds are important in environmental analysis, because they impact water quality and introduce potential (eco)toxicological effects. Current analytical methods mostly rely on gradient liquid chromatography (LC) or reversed-phase liquid chromatography (RPLC) coupled with (tandem) mass spectrometry. However, neither method can easily separate very polar compounds. Two chromatographic separation strategies, a serial RPLC- hydrophilic interaction liquid chromatography (RPLC-HELPIC) coupling and an analytical scale supercritical fluid chromatography (SFC) system will be presented, and their separation effectiveness as polarity-extended chromatographic methods for 274 environmentally relevant compounds were validated in a recent publication [1]. Compounds tested were grouped into three polarity classes, “very polar” log D (pH 7) below -2.5, “polar” log D (pH 7) -2.5 to -2, and “non-polar” log D (pH 7) higher than -4.2. Nearly all compounds could be retained in both systems with relative standard deviations of retention times (RT) (n = 6) typically between 2 and 5%. Both techniques have considerable benefits when combined with accurate mass spectrometric detection. Molecules RT and accurate mass were recorded in a database for each set up. This information was used for compound screening of unknowns. One advantage of “hidden-target screening” in complex environmental matrices (such as wastewater treatment plant effluent samples) is that it can be used in a complementary and useful for all types of molecules polarity. In this study, more than 80 percent of the compounds found in wastewater treatment plant effluent samples possessed a negative log D (pH 7) value. This result highlights the basic necessity to include “very polar” compounds in water monitoring techniques and protocols. [1] S. Bieber, G. Grova, S. Grosse, T. Letzler: RPLC-HELPIC- and SFC with mass spectrometry: Polarity-extended organic molecule screening in environmental (water) samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

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Removal options and transformations of persistent mobile organic chemicals during production of drinking water
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Persisted mobile organic compounds (PMOCs) are water soluble, non-volatile and are thus mobile in the water cycle. Because of their intrinsic properties, they are able to penetrate natural and artificial barriers and may constitute a threat for drinking water. Advanced treatments like activated carbon and oxidation processes can be used to limit the presence of organic micropollutants in drinking water. However, low removal by activated carbon is expected for PMOCs due to their higher polarity. The behavior of PMOCs in drinking water can be evaluated at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation of ozone and chlorine. Highly polar PMOCs such as adamantane-1-amine (Log D = -2.34), trifluoromethanesulfonate (Log P = -3.35) and caprolactam (Log P = 0.15) were not recovered by PAC even for very high doses. Only naphtalenesulfonate (Log P = -0.41) was fully removed for 5 mg L-1 PAC. The other PMOCs i.e. aromatic sulfonates, aromaticamines, 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-1s-1 and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-diphenylguanidine and the 1,3-di-o-tolyguanidine, an olefinic sulfonate and an amine compound, the N-benzylidentimidine, 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 PMOCs identified in drinking water resources can be transformed by ozonation and chlorine. Both techniques are used to transform organic compounds into more reactive intermediates, which can be further removed by oxidation processes and could thus be present in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.

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Removal of polar micropollutants from drinking water by reverse osmosis: a pilot scale study
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The occurrence of polar micropollutants (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. We report a pilot scale RO system capable of operating in anaerobic reactor conditions and are thus mobile in the water cycle. Because of their intrinsic properties, they are able to penetrate natural and artificial barriers and may constitute a threat for drinking water. Advanced treatments like activated carbon and oxidation processes can be used to limit the presence of organic micropollutants in drinking water. However, low removal by activated carbon is expected for PMOCs due to their higher polarity. The behavior of PMOCs in drinking water can be evaluated at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation of ozone and chlorine. Highly polar PMOCs such as adamantane-1-amine (Log D = -2.34), trifluoromethanesulfonate (Log P = -3.35) and caprolactam (Log P = 0.15) were not recovered by PAC even for very high doses. Only naphtalenesulfonate (Log P = -0.41) was fully removed for 5 mg L-1 PAC. The other PMOCs i.e. aromatic sulfonates, aromaticamines, 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-1s-1 and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-diphenylguanidine and the 1,3-di-o-tolyguanidine, an olefinic sulfonate and an amine compound, the N-benzylidentimidine, 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 PMOCs identified in drinking water resources can be transformed by ozonation and chlorine. Both techniques are used to transform organic compounds into more reactive intermediates, which can be further removed by oxidation processes and could thus be present in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.
RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultra-high-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPs displayed less than 5% passage, except benzotriazole, tolyltriazole 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 the case. This passage was we further observed 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 on the membrane surface explains the findings. 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 contaminants and their relevance in the water cycle

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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 microbial and chemical degradation, their removal during water treatment and drinking water purification may prove difficult. Toxic 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. acsesulfame, glyphosate) have been extensively studied and monitored.

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 water contaminants. 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. and Schulze et al., we selected 15 industrial chemicals with a high expected potential to form transformation products and studied their behaviour during hydrolysis, biotransformation, oxidation with MnO2, and photolysis 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 found in the majority of the screening samples suggests 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

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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 chemical application domain, i.e. a chemical property space in which the 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, and we are doing this with regulatory frameworks that were in some cases developed 20 years ago with a more modest level of ambition. As time passes, societal concerns can arise because of the inclusion 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/compartments. 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?

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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/pvP 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 pvP 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 the legislations.

Product benefits and positive outcomes: valuation and beyond

374 A need for a better characterisation of product benefit in life cycle sustainability assessment

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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 product use activities are stated, but the whole 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.

We consider a respective product benefits and positive outcomes framework that is built up of three perspectives. First, 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. Second, 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 holistic sustainability assessment systems instead of not having it. Third, when an additional amount of byproduct is created by a production system, this may also induce a byproduct benefit, which can be
accounted for as such. In fact, when a byproduct enters the market, a share of it can lead to a decrease in supply (substitution approach) but another share can also lead to an increased demand and thus consumption, which satisfies needs that were previously unsatisfied (production benefit approach). A consideration of both effects is needed in CLCA.

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

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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 sodium), 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 dALY/y. We also develop a profiling system for 6000+ food items contained 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 dALY/y for sodium, up to 57 avoided dALY/y for omega-3 from seafood. HENI score typically ranges from -80 avoided dALY/serving for Frankfurter sandwiches to 50 avoided dALY/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 mixed 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 sodium. 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 could propose 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

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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, 20% of household expenditure is destined to food purchase. In contrast, malnourishment is still rampant in many socio-economic sectors, mainly in the Highlands 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 costs, 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

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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 do. Our study looks into the monetary values of 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

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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 strategy, 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 reduced 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, EPS2015 and ReCiPe2016. The damage cost for CO2 is in the same order of magnitude in EPS2015 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

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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 NO_x, and occupational incidents. 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 times higher than for the source control action (MNA) could have achieved a 30% reduction in the total health impact, without the need for substantially more expensive and labour intensive remediation. Potential benefits of MNA are further highlighted when resuspension is an important factor. Furthermore, potential health impacts created by the selected remedy are within the same order of magnitude as potential benefits. One of the main issues to validate efficacy of remediation is to assess ecosafety (safe-by-design) of new developed nanomaterials as well as their suitability for in situ application within the geotextile in terms of environmental impact will be presented.

383 Possibility of using a genotoxic tests in planning precise phytoremediation of depleted soils enriched in organic amendments
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A number of soils at many sites became a source of harmful organics due to the accumulation of antibiotic and pharmaceuticals. In addition, they can easily transport the bioaccumulated pharmaceuticals to the biosphere through the food chain, thus becoming a significant health risk for human health. Determine and compare the avoided health impacts, with the created health impacts and there is a general demand for strategies to fulfill such needs. As the potential and efficacy of nanotechnologies is well established, several drawbacks of nanotechnologies include their potential adverse effects on the environment and human health. Therefore, there is an urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and the long-term sustainability of the remediation interventions.

384 Sorption of pharmaceuticals in soil systems
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In situ remediation of sludge and dredged harbour sediments is currently highly cost-effective despite an ever increasing number of sites requiring swift treatments to reduce contamination. Therefore there is a urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and the long-term sustainability of the remediation interventions.

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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 pharmaceutical 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 been decisive role for the environmental behaviors and the ultimate fate of pharmaceuticals (Drillia and Lyberatos, 2005). However, relatively a few investigations of the sorption of organic compounds at the group level based on the dissocation 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 characteristics on the sorption of organic compounds in the soil environment. 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

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Chlordecone (Kepone) (CLD) is a highly persistent pesticide formerly used in French West Indies. Nowadays high levels of this pesticide are still found in soils which represent a subsequent source of contamination for outdoor-reared animals. In that context, sequestering 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 test protocol prior in 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. Four piglet livers were exposed to CLD contaminated soils. Only treatment groups exposed through amended soil with ACs presented significant decreases CLD availability, bioavailability (<8%). Similar results were found using both in vitro assays. At last, concentrations of CLD in piglets 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 transfert (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

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The sources of environmental pollution with polychlorinated biphenyls along with the energy production/ distribution complex include landfills, many of which do not correspond to environmental requirements and are the only attribute of the “consumer” relationship to nature, thus bringing forth a number of problems and a great danger for the normal functioning of biocenosis. In the present research we used samples of released chlordecone from the dumps and agricultural fields or water basins near some settlements of Armenia. The following 14 dioxin-like polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 170, 180, 189. Quantitative determination was carried out using chromatography with electron capture detectors (ECD) equipped with gas capillary column with stable phase DB-5MS UI and the following parameters: 60 m x 0.250 mm i. d. x 0.25 µm. Special attention was paid to the total amounts of polychlorinated biphenyls, as the total amount of these compounds correlates with the hygienic standards, which as such are integral

values. In all investigated soil samples dioxin-like PCBs were detected, however, in this study we mainly recorded 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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Associated Health Effects of Veterinary Pharmaceutical Residues in Watersheds around Selected Livestock Agriculture Farms in Western Cape Province

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Livestock farming is a major industry in the Western Cape Province of South Africa and livestock agricultural farms have been suggested to be a major source of pharmaceutical residues in many aqueous matrices, due to their enormous use. Pharmaceutical products such as steroids and non-steroids hormones, antibiotics and non-steroidal anti-inflammatory drugs from agriculture have been indicated to have the potential to show significant endocrine and other health effects. In this study, a High Performance Liquid Chromatography coupled to ultraviolet detector (HPLC-UV-Vis) method was optimized and validated for the detection and separation of the selected pharmaceuticals in effluents for livestock farms with major activity in the study areas. Multi-residue solid phase extraction (SPE) procedure was developed and validated for the recoveries of acetaminophen (AC), diclofenac(DF), salicylic acid (SA), tetracycline(TC), chloramphenicol(CHR), ciprofloxacin(CIP), bispirones(BPA, 17β-estradiol(E2), estriol(E3), and ivermectin(IV) from agricultural wastewater using the hydrophilic-lipophilic balance(HLB)-SPE column. Recoveries of the pharmaceuticals from standard aqueous solutions spiked concentrations of between 2 and 10 µg/l were: E2, 76.62 – 85.47 %; AC, 78.29 – 94.34 %; TC, 88.35 – 92.15 %; CHR, 76.62 – 88.35 %; SA, 79.38 – 81.49 %; E3, 85.42 – 92.15 %; BPA, 80.27 – 89.42 %; CP, 76.58 – 90.21 %; DP, 75.46 – 87.55 % and IV, 80.27 – 84.89 %. Various levels of veterinary drugs – AC, < 0.48 – 1.07 µg/l; SA, < 1.37 – 15.49 µg/l; TC, < 3.45 – 4.57 µg/l; CP, 0.45 – 2.46 µg/l; and IV, < 1.74 – 1.63 µg/l were detected in the grab water samples. The results of the health risk assessment clearly showed mutagenic activity being observed in samples from sheep and poultry farms. It also showed high estrogenic activity in the pig farm. The results indicated that making use of the maximum concentration of 17β Estradiol found in the samples, there was a slight risk of developing cancer through accidental ingestion via recreational activities with higher risk if the water was used for domestic purposes without treatment to remove them or if the water was used for irrigation purposes.

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

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Water is nowadays a precious resource on which anthropic pressure increased drastically these last years, due to global lifestyle improvement and the population growth. Pesticides are part of the most preocupant 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 input to water treatment plants. Treatment of pesticides can be quite expensive and inputs may not be clearly identified or colligated. In order to assess. This 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 a 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 parvo and veterinary products, especially in slow-flow period when the WWTP contributes 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
Study of bioconcentration of benzophenone-3 in gill-head Bream and characterization of its transformation products in a seawater and plant system

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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 lipophilic 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 higher in comparison to the rest of tissues/fluids. Since BP-3 is hydrophobic and non-ioniczable compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipicic) 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 lipicic) 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 tissue/biofluids (mainly in bile and liver). By the interpretation of the MS2 spectra, we identified demethylation, hydroxylation and glucoronidation 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 (ED431C2017/36) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry of Science and L. Mijangos to the Basque Government for their predoctoral fellowships.

Pharmacology of ibuprofen and other non-steroidal anti-inflammatory drugs

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Phytoremediation is an emerging technology that utilises green plants and their associated rhizosphere microorganisms to clean polluted environmental media. However, the role of plants in removing organic pollutants is still not well understood. Phytoremediation of realistic environmental concentration (10 µg L−1) of the chiral pesticides tebuconazole and imazalil by a wetland plant, Phragmites australis, was investigated. The experiment was carried out in a glass laboratory using plants of similar initial size (6.0 ± 0.2 g fresh biomass). The plants were placed in 700 mL glass vessels containing 500 mL hydroponic solution. The pesticides were spiked separately (n=27 for each) in parallel with control samples (n=15). The experiment ran for a period of 24 days. Enantioselective fractionation and transformation products (TPs) in both hydroponic growth solutions and plant tissues were measured by HPLC-QTOF-MS. The uptake, translocation and metabolism of tebuconazole and imazalil inside Phragmites australis were documented for the first time using enantioselective analysis. The pesticides removal efficiencies from water were 96.1% and 99.8%, respectively, by the end of the experiment (day 24). Removal from the solutions could be described by first-order removal kinetics (k=0.14 d−1 for tebuconazole and k=0.31 d−1 for imazalil). Four different processes occurred simultaneously: 1) removal of the pesticides from the hydroponic solution, 2) plant uptake, 3) pesticides translocation in the plant, and 4) degradation within the plant. Tebuconazole and imazalil concentrations inside Phragmites showed a maximum level at day 10 and 5, respectively, followed by a decrease of both compounds concentration. Two TPs of tebuconazole could only be quantified in solution, while two imazalil TPs were quantified in both solution and plant tissue. The uptake of both pesticides was positively correlated with evapotranspiration. The removal of imazalil and tebuconazole from the hydroponic solution was not enantioselective, however, both translocation and degradation inside Phragmites were enantioselective. For tebuconazole, the enantioselective degradation was found in both Phragmites roots and shoots.

Effects of the non-steroidal anti-inflammatory ibuprofen on growth and metabolic profiles of Vigna Unguiculata

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The non-steroidal anti-inflammatory ibuprofen is one of the most frequently detected pharmaceuticals in wastewater treatment plants. Its metabolism has been widely studied in mammals, fungi and microbes. However, little is known on how ibuprofen is metabolized by plants, mostly due to analytical methodology gaps for determining these compounds at low concentration in complex matrices. In this study, the effects of ibuprofen treatment on the growth and its comprehensive metabolic profile in whole plant cultures and seed germinates of Vigna 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 ibuprofen, 1 and 2-hydroxyibuprofen and carboxyibuprofen 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 Giza area of Saudi Arabia, were germinated in Petri 'plates or sown on soil at a concentration of 400, 800, 1200, 1600, and 2000 mg L−1 of ibuprofen). Seeds and plants were incubated in a growth chamber in the dark at 26 ºC for 5 days. Forty-six metabolites of ibuprofen in V. unguiculata were successfully identified. The 1-hydroxy and 2-hydroxy ibuprofen were confirmed and quantified using their analytical standards. The structures of the other metabolites were proposed using high resolution mass spectrometry (HRMS) and high resolution tandem mass spectrometry (HRMS/MS) data. In particular, the combination of mass accuracy and the fragmentation patterns of metabolites and parent compounds allowed proposing plausible structures for each metabolite. Six hexosides were already reported in study on Phragmites australis and Lemna gibba. Thirty-eight of the identified metabolites were already reported in a study on Cacalia cultures of A. thaliana and 9 of them (conjugates of ibuproofen or hydroxyibuprofen with amino acids) are, up to our knowledge, reported for first time in plants.

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

Environmental Risk Assessment of Active Pharmaceutical Ingredients used in Human Medicinal Products: Europe-wide Variation in Risk Quotient

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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(3) of Directive 2001/83/EC, as amended by Directive 2008/50/EC, 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 environmental impacts. This poster will present 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-infective 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 (PEC) and predicted environmental concentration (PEC) multiplied by a specific dilution factor applying the 5th percentile and the variability in the risk quotients (RQs) for each API across Europe and (v) looked at the impact of country-specific dilution factors applying the 5th percentile and the variability in the risk quotients (RQs) for each API across Europe and (v) looked at the impact of country-specific dilution factors applying the 5th percentile and
392 Development and validation of a model to predict concentrations of human APIs in European surface waters
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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 for bioaccumulation assessment for many chemicals. This study addresses the development of QSAR models for the prediction of in vivo whole body human biotransformation half-lives measured or empirically-derived for over 1000 PPCPs, mainly represented by pharmaceuticals. First, two sets with data on half-lives for human volunteers (Hlv-Hv) and the derived whole body in vivo biotransformation half-life (HLV) were used to develop HL-QSAR models based on theoretical molecular descriptors. The statistical parameters calculated for the models reflect the good ability to fit the data in the training sets (R² range: 0.77 – 0.80) the robustness (Q²LOO and Q²LMO range: 0.77 – 0.79) and the external predictivity (Q²ext range: 0.75-0.79; CCC range: 0.86-0.87). These QSARs were used, in combination with literature models for the prediction of biotransformation half-lives in fish, to refine the screening of the potential PBT behaviour of over 1300 PPCPs. Principal Component Analysis (PCA) was applied to combine experimental biotransformation half-life data and reliable QSAR-predictions to assess biotransformation process in multiple species (i.e. fish, rodents and human). The proposed approaches can be helpful to highlight the most problematic PPCPs, according to their slow or fast potential for biotransformation, i.e. 22 slowly biotransformed compounds were highlighted as potential PBTs, 18 compounds formerly detected as PBTs resulted easily metabolized, while the PBT behaviour of 59 PPCPs may have been underestimated. This study highlights the importance of biotransformation for the refinement of screening level assessments of Bioaccumulation and Bioactivity-related behaviour (i.e. potential PBT behaviour) of chemicals and shows how in silico approaches can be efficiently integrated to support these assessments.

395 Occurrence and fate of the antidiabetic metformin and its transformation products
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The occurrence and fate of the antidiabetic metformin (MF) with its well-known main metabolite guanyl ura (GU) has been studied in WWTPs. So far, no other APIs of metformin are reported in the water cycle. In this study, electrochemical experiments for simulation and identification of potential new APIs of MF were performed. In addition we investigated the occurrence and fate of MF and its APIs in WWTP and surface water. Analysis was performed by LC-high-resolution-mass-spectrometry (HRMS) using HILIC (hydrophilic interaction chromatography) and quadrupole-time-of-flight mass spectrometry (QTOF-MS). Four APIs of MF have been identified after electrochemical degradation. The proposed structures are four-amino-2-imino-1-methyl-1,2-dihydro-1,3,5-triazine (4,2-AMT), 2-amino-4-methylamino-1,3,5-triazine (2,4-AMT), 2,4-diamino-1,3,5-triazine (2,4-DAT) and methyl-benuguanide (MBG). The mass error was below 3 ppm for all 4 APIs. However, the well-known TP GU could not be formed electrochemically. The APIs found are similar to those of a former study using gamma radioisotopes (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 influents 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 APIs no authentic standards were available, however TPs 2,4-DAT and 2,4-AMT showed similar increasing abundance trends from influents to effluents, 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 WWTP effluent samples. The study is performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Württemberg.

396 Development of biotransformation half-life QSAI models and PBT assessment of Pharmaceuticals and Personal Care Products in European surface waters
E. Papa, A. 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, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA); D. Boullier, University of Paris and Paris CNRS/Canopé, France / PPARC, France, of particular interest for the environment since it has been demonstrated that many of them are persistent or “pseudo-persistent” due to their extensive use and continuous emission. They have potential for bioaccumulation in organisms of different trophic levels and exposures to PPCPs can result in acute and chronic effects in target and non-target organisms. Guidelines for Environmental Risk Assessment of human medicines require, in the first monograph phase, an assessment at two levels: if a PPCP is defined not persistent, bioaccumulative and toxic (PBT), Biotransformation has been recognized as a key determinant for bioaccumulation assessment for many chemicals. This study addresses the development of QSAR models for the prediction of in vivo whole body human biotransformation half-lives measured or empirically-derived for over 1000 PPCPs, mainly represented by pharmaceuticals. First, two sets with data on biotransformation half-lives (HLv-Hv) in human volunteers and the derived whole body in vivo biotransformation half-life (HLV) were used to develop HL-QSAR models based on theoretical molecular descriptors. The statistical parameters calculated for the models reflect the good ability to fit the data in the training sets (R² range: 0.77 – 0.80) the robustness (Q²LOO and Q²LMO range: 0.77 – 0.79) and the external predictivity (Q²ext range: 0.75-0.79; CCC range: 0.86-0.87). These QSARs were used, in combination with literature models for the prediction of biotransformation half-lives in fish, to refine the screening of the potential PBT behaviour of over 1300 PPCPs. Principal Component Analysis (PCA) was applied to combine experimental biotransformation half-life data and reliable QSAR-predictions to assess biotransformation process in multiple species (i.e. fish, rodents and human). The proposed approaches can be helpful to highlight the most problematic PPCPs, according to their slow or fast potential for biotransformation, i.e. 22 slowly biotransformed compounds were highlighted as potential PBTs, 18 compounds formerly detected as PBTs resulted easily metabolized, while the PBT behaviour of 59 PPCPs may have been underestimated. This study highlights the importance of biotransformation for the refinement of screening level assessments of Bioaccumulation and Bioactivity-related behaviour (i.e. potential PBT behaviour) of chemicals and shows how in silico approaches can be efficiently integrated to support these assessments.

397 Predicting spatial and temporal variability in internal concentrations of antimyrtine in invertebrates within an urban catchment
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The University of York / Natural and Built Environments; R. Ashauer, 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 variation in uptake and this approach was based on environmental pH measurements in York City, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Due to two pH instabilities (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. variegatus varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Ouse (which had a concentration range of 0.5-2.2 pmol/g) than for the river Foss (which had a concentration range of 0.2-0.9 pmol/g) and a pH range of 7.3-8.4) than the river Ouse (which had a concentration range of 0.2-0.9 pmol/g) and a pH range of 7.4-8.4) 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 reveals 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
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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 the most suitable. The aim was to adapt non-standard species. Most tests were performed based on the Lemna guideline OECD 221, the two Myriophyllum spicatum guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum sibiricum, Sediment contact test with Myriophyllum aquaticum (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (Aquatic Macrophyte Risk Assessment). For the sediment test on Myriophyllum aquaticum, 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; Presentation at 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 monoculture dose-responses: Testing the plant community model IBC-grass with experimental data
A. Kammerer, University of Potsdam / Plant Ecology and Nature Conservation; S. Heine, Bayer Ag / Effect modelling; C. Milian, Bayer CropScience AG / Ecotoxology; 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 of paramount importance for their credibility as 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 monocultures 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 monocultures as well as for the communities. Model adequacy was lower in the monocultures. However, model adequacy increases in the communities. In general, model reliability is high in the monocultures and adequate in the community set up. This study may 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
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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, ecologists are evaluating the risk of chemicals to plant species. This 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 a day after exposure, 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 mesocosms studies the concept of recovery is even further

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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, lemmna, 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. Hemmann, 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 (EC50s) is used in the first tier. The EC50s can be expressed as inhibition of the average specific growth rate (ErEC50) or as reduction in biomass, calculated from yield (EyEC50) or as the integral under the growth curve (EhEC50). The lowest available EP among ErEC50, EhEC50 or EyEC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use ErEC50s 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 ErEC50) shifts thus the level of conservatism of a factor of 6.9 and 3.5 for algae and Lemnna 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 ECx, (EC10, EC20 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
Environmental monitoring of contaminants using terrestrial ecological biomonitor

404 Persistent Organic Pollutants in Germany: Results from the 2015/2016 moss and OES sampling
A. Dreyer, Eurofins GFA GmbH / Air Monitoring; S. Nickel, University of Vechta / 2, J. Koschorreck, Umweltbundesamt; W. Schröder, University of Vechta / 2
This presentation aims at reporting on the determination of selected POPs in eight moss samples from Germany within the framework of the 2015 European moss survey and comparing the respective results with those derived for leaves and needles collected for the German Environment Specimen Bank (ESB). The moss samples were collected in areas located in the vicinity of tree sampling sites from the ESB in fall 2016. Deciduous tree leaves and coniferous shoots were sampled in 2015 or 2016 according to the ESB protocols. Overall, 17 polybrominated dibenzo-p-dioxins and -furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoroalkyl substances (PFAS), 3 Isomers of hexabromocyclododecane (HBCD), 7 polybrominated diphenyl ethers (PBDE), 24 polybrominated diphenyl ethers (PBDE), and 21 alternative halogenated flame retardants (HFR) such as Dechlorane Plus were determined. Except for PBBs and PFASs, POPs of all substance groups could be quantified, although to different extents. Concentrations of individual PAHs and HFRs were in the same order of magnitude as those observed in coniferous shoots or deciduous tree leaves from nearby located areas. Highest levels of PCDD/F, d1-PCBs, HBCD and PAH in moss were observed at sites close to the Belauer See (Northern Germany, agricultural land-use) and the Harz National Park. Concentrations of PBDEs were highest at the two sampling sites in Saarland (conurbation) and at the Harz site. Concentrations for Dechlorane Plus were highest at the Harz site followed by sites located at Solling (forestry) and Seyeren (agricultural) and were lowest at the site in the Halle-Leipzig conurbation. Thus, surrounding land-use does not seem to be the (only) driving force determining the POPs burden in moss samples. PBDE moss concentrations observed in this study were similar to those observed at background sites in Spain and lower than those of background/remote sites in Norway. Concentrations of Dechlorane Plus were more than a factor of 100 higher than moss concentrations reported for Svalbard (Arctic Norway).

Mapping percentile statistics of element concentrations in moss collected from 1990 to 2015 in forests throughout Germany
W. Schröder, S. Nickel, University of Vechta / 2
Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, technical sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss samples have been collected at 7500 sites in 76 countries. For selected elements, 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 in the focus of this paper. Therefore, 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. 

References

406 Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochemistry
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. Schlösser, University of Hohenheim / Core Facility Hohenheim; E. Demaria, 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. These effects on the quality of food at the human level. 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 P. pinaster Ait.), i.e. evergreen deciduous and coniferous species common to Mediterranean ecosystems. 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, Si, Al, Ba, Cr, Ni, V, Fe, Hg, P, K, Mg, As, Pb, Cd, Zn, Cu and S. Apart 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 variation 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 agriculture.

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; L.E. Kimpe, University of Ottawa / Department of Biology; J.P. Smol, Queens University / Biology; W. Bogdanowicz, Museum and Institute of Zoology;
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 ancient environmental archives as the cave environment preserves stable isotopes of 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 $^{210}Pb$, $^{137}Cs$, and $^{14}C$ dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years old. We constructed the $^{210}Pb$, $^{137}Cs$, and $^{14}C$ 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 stigmasanol, for example, could be evidence of fluctuations in feeding habits (e.g. from South to North). Another deposit that 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 $^{210}Pb$ within the bat guano deposit in association with the introduction of leaded gasoline.

408 Perfluoroalkyl substances and metallic elements in South African dryland flounders

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Adult flounders are aerial predatory arthropods that occur globally. However, no research on adult flounders as potential indicators of environmental metallic contamination has been carried out with little information on PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that flounders from farming areas had significantly lower $^{222}Rn$ concentrations than sites located closer to industrial areas (median $^{222}Rn$ of 1.9 Bq/m$^3$) compared to sites located further from pollution sources (PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult flounders were collected and analysed for PFASs and metallic elements. The results indicated that floun...
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. Aromatic and serotonin are involved in osmoregulation, and in general release in mollusks [2-4]. Our results highlighted potential impairment of mussel osmoregulation and reproduction following a DCF exposure in agreement with recent 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 mice

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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 biologically 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 Child” investi-gates 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 (sub)clinical 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 Pollutant and Metabolomics Profiles in Tissues of Polar Bears From Hudson Bay, Canada

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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 (representative subpopulations which liberate small metabolite-rich fractions; SHB: n = 14) and Western Hudson Bay (WHB; n = 15) male polar bears were combined 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'-dichlorodiphenyldichloroethylene (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 were identified as being differently enriched or impacted between the subpopulations. Greater ARA in SHB bears may be related to differences in chronic exposure to POPs such as the hepatotoxic PFASs, as ARA is part of the inflammatory response in liver. SDMA and most legacy organochlorine compounds were greater in the WHB bears, which may be indicative of differences in renal function. Consistency of relationships between metabolites, POPs, biomarkers from laboratory studies suggests linkages between POP concentrations and differences in the hepatic metabolome of SHB and WHB polar bears.

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

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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 organisms of its taxon 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, the proposed objective was to 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.
stress and lipid metabolism. Finally, there were also several genes that were among the enriched separately for diuron and atrazine, 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.

**Harmful effects of plastic litter and mitigation strategies in the Mediterranean Sea**

416 **Harmful effects of plastic litter on Mediterranean Biodiversity: what and what’s new?**

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 NGOs, 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 biondicator species could better integrate the spatial and temporal presence of marine litter/microplastics in the marine environment. In addition, the use of biondicators 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 measured biological 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, biondicator 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 biondicators 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. Glibaudi, IFREMER

Periodic 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 observed 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. Vlahogianni, 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 environment and conservation issues in the Mediterranean 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 amplified 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 policy, 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 zone. The term “biodegradable” could be misunderstood and used in a specific and 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 inconvenient truth that if, for instance, pesticides are 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.

419 **Biodegradable plastics: potential application in aquaculture and other applications at high risk of dispersion**

F. Deeli Innocenti, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and mass investments in a material that prevents recycling and recovery programs. Bioplastics can be the right solution for specific products, if properly applied. Bioplastics hold promise for aquaculture professional applications (e.g. nets for mussel farming) where the disposal of plastic waste is an inevitable outcome. Bioplastics can be the right solution for specific products, if properly applied.

420 **Marine Litter Governance in the Mediterranean through the implementation of the Regional Action Plan on Marine Litter Management in the Mediterranean**

T. Humm / UN Environment / Mediterranean Action Plan Coordinating Unit; G. Leone, UNEP/Mediterranean Action Plan

The UN Environment/ MAP Barcelona Convention was the first Regional Sea Programme to approve a legally-binding Regional Plan on Marine Litter...
Management (RPML) in December 2013, providing for a set of programmes of measures and implementation timetables to prevent and reduce the adverse effects of marine litter on the marine and coastal environment. It includes innovative and traditional measures of a policy, regulatory and technical nature, addressing different aspects of marine litter prevention and management from land and sea based sources. The Regional Plan measures impose clear obligations regarding the waste management hierarchy, closure of illegal dumping/dumpsites, shift to sustainable consumption and production patterns, removal of existing marine litter using environmental sound practices e.g. fishing for litter, clean up campaigns, port reception facilities at possibly no special fees, and monitoring, assessment and reporting on implementation of measures as well as enforcement of national legislation. Significant effort has been made on marine litter at regional and national levels, since the adoption of the RPML. The Mediterranean countries have included marine litter in their updated National Action Plans (NAPs) and the ambitious and novel Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria has been adopted since 2016 by the Mediterranean countries including two common and one candidate indicators on marine litter. Furthermore, with the support of the EU-funded Marine Litter MED project, UN Environment/IMAP is implementing key reduction and prevention measures on marine litter in the Southern Mediterranean. At the invitation of the UN Environment/MAP, the Regional Cooperation Platform on Marine Litter in the Mediterranean was established in September 2016, consisting of more than 20 international and regional partners with a clear mandate on marine litter management. The aim of the platform is to assist to the cooperation with the RPML and IMAP activities, 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 “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 University of Siena, a further step has been resulted, carrying out studies and research on the presence of contaminants adsorbed by floating plastics and their potential effects on biodiversity. The first results of this research will be presented in this meeting.

422 Discussion

423 Final Remarks

G. Leone, UNEP/Mediterranean Action Plan

Ecological 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-Català, Universitat de Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; I. Muñoz, University of Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; E. Kalogianni, I. Karouzas, A. Vourka, E. Smeti, L. Vardakas, Hellenic Centre for Marine Research, Institute of Marine Biological Resources & Inland Waters (HCMR); M. Paunovic, University of Belgrade, Institute for Biological Research Sinisa Stankovic; C. Borrego, M. Petrovic, Catalan Institute for Water Research ICRA, S. Sabater, ICRA Catalan Institute for Water Research; S. Diaz-Cruz, M. Farre, IDAEA-CSIC / Environmental Chemistry; S. Monllor, N. De Castro Exeter / Department of Biosciences; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; T.S. Galloway, University of Exeter / Biosciences Increasing pCO2 in aquatic environments is occurring as a consequence of the release of anthropogenic carbon dioxide in to the atmosphere, which is absorbed by surface waters. Traditionally this stressor has been studied in isolation, however environmental variation such as changes in pH or pCO2 can alter the ionisation and consequently the effects of contaminant compounds. A notable group of compounds susceptible to these changes include the active pharmaceutical ingredients (APIs), which often have pH-specific biological effects and are increasingly detected in sewage effluent and receiving waters. The aim of this study is to investigate the hypothesis that changes in pCO2 alter the effects of active pharmaceutical ingredients on sperm swimming parameters and fertilisation success. The species chosen to explore these effects were the lugworm Arenicola marina and the purple sea urchin Paracentrotus lividus due to them being keystone coastal species in areas where API contamination is occurring, and them being established model species for artificial spawning in controlled laboratory conditions. We used a range of non-steroidal anti-inflammatory drugs (NSAIDs) at both environmentally relevant and mechanistic concentrations to test this relationship due to them having chemical properties identified as making them pCO2-sensitive. pCO2 conditions equating to current (8.10 ± 0.1) and future (7.75 ± 0.1) pH conditions were selected for this study. Endpoint measured included a range of sperm motility parameters, using computer-assisted sperm analysis (CASA) software and fertilisation success. Our findings indicate that pCO2 conditions may play a vital role in altering the toxicity of common chemical pollutants through changes in sperm swimming parameters and consequently fertilisation success. Our results also indicate that this combination of stressors is compound-specific between contaminants with multidirectional effects dependent on conditions of the exposure. Our findings provide novel evidence that future environmental conditions may substantially alter the role which contaminants such as APIs play in the environment. API contamination is likely to increase following anthropogenic pressures such as population growth and healthcare advances. As a result, we believe it necessary to consider future conditions such as increased pCO2 conditions when accurately assessing the environmental risks of such compounds.

425 Changes in pCO2 alter the reproductive toxicity of common active pharmaceutical ingredients C.M. Hitz, N. Wichman, C. Lewis, K. Smith, A. Wilson McNeal, University of Exeter - Department of Biosciences; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; T.S. Galloway, University of Exeter / Biosciences Increasing pCO2 in aquatic environments is occurring as a consequence of the release of anthropogenic carbon dioxide in to the atmosphere, which is absorbed by surface waters. Traditionally this stressor has been studied in isolation, however environmental variation such as changes in pH or pCO2 can alter the ionisation and consequently the effects of contaminant compounds. A notable group of compounds susceptible to these changes include the active pharmaceutical ingredients (APIs), which often have pH-specific biological effects and are increasingly detected in sewage effluent and receiving waters. The aim of this study is to investigate the hypothesis that changes in pCO2 alter the effects of active pharmaceutical ingredients on sperm swimming parameters and fertilisation success. The species chosen to explore these effects were the lugworm Arenicola marina and the purple sea urchin Paracentrotus lividus due to them being keystone coastal species in areas where API contamination is occurring, and them being established model species for artificial spawning in controlled laboratory conditions. We used a range of non-steroidal anti-inflammatory drugs (NSAIDs) at both environmentally relevant and mechanistic concentrations to test this relationship due to them having chemical properties identified as making them pCO2-sensitive. pCO2 conditions equating to current (8.10 ± 0.1) and future (7.75 ± 0.1) pH conditions were selected for this study. Endpoint measured included a range of sperm motility parameters, using computer-assisted sperm analysis (CASA) software and fertilisation success. Our findings indicate that pCO2 conditions may play a vital role in altering the toxicity of common chemical pollutants through changes in sperm swimming parameters and consequently fertilisation success. Our results also indicate that this combination of stressors is compound-specific between contaminants with multidirectional effects dependent on conditions of the exposure. Our findings provide novel evidence that future environmental conditions may substantially alter the role which contaminants such as APIs play in the environment. API contamination is likely to increase following anthropogenic pressures such as population growth and healthcare advances. As a result, we believe it necessary to consider future conditions such as increased pCO2 conditions when accurately assessing the environmental risks of such compounds.

426 From individual traits to ecosystem functioning: natural phytoplankton community responses under combined environmental stress and chemical pollution D. Bahlo, Norwegian Institute for water research; E. Leu, Akvaplan-niva AS; F. Pedersen, Fagwag Ecology, Department of Aquatic Science and Environmental Engineering; E. J. Moe, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; D. H. Hessen, University of Oslo / Department of Biosciences; J. Norberg, Stockholm Resilience Centre; L. Nizzetto, NIVA Phytoplankton are crucial for lentic ecosystems productivity and foodwebs, but facing multiple anorophic challenges that may lead to complex alterations of their ecology and function. Climate change is expected to decrease the stability of lentic ecosystems and enhance fluctuations in environmental conditions. More frequently occurring storm events will potentially disrupt the normal stratification patterns in boreal lakes, thereby dispersing algae from the depth layers they are optimally
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 promote significant shifts in community composition and abundance in response to 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 of a mixture of chemical pollutants added to the mesocosms at five increasing concentrations (typically considerably below the EC₅₀ of individual stressor). 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, pigmentation), community parameters (biomass, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 3-weeks experiment. Our results showed that environmental contaminants with 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 pollutants can disrupt the capacity of natural communities to handle environmental changes.


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 present study was designed to evaluate 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. Assuncção, Celas Lowsoft Laboratory; P.E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; H. G. Mozaz, Institute for Water Research (ICRA) / Water Quality; P. Capri, Università degli Studi di Firenze / Department of Civil, Environmental and Mechanical Engineering; E. Gabbert, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Upgrading; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecol...
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 exposure assessment 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 activity, multipliers of a PBT/vPvB substance and to benchmarks, being 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 perfluorocane sulfonate (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. Nedeva, 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; G. van der Sloot, Wageningen University / Social 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 process is to establish a measure of 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 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 possibilities to: (1) assess the potential impact 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 possibilities to: (1) assess the potential impact 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 possibilities to: (1) assess the potential impact of PBT/vPvB substances on the environment and on human health via the environment (toxicological benchmarks), and to other specific concerns.

432 Interpretation of non-extractable residues (NERs) in the persistence assessment

U. Horweck, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; 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 remobilised 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 terms are used for NERs (e.g. NERs – soil residues, non-extractable residues). Different classification systems exist for NERs (e.g. strongly sorbed and chemically bound residues are relatively easy to distinguish from bound residues, which are not distinctly related to a chemical compound (e.g. bound to the soil). The identification and quantification of NERs is of high importance in the context of socio-economic analysis under REACH and the Biocides Products Regulation (BPR). It also provides a tool for further research needs and for addressing the limitations identified in the current testing guidelines. The main outcome of the project will be presented at the SETAC meeting.

433 Quantification of different NER types in soil - Extraction matters


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 remobilised 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 terms are used for NERs (e.g. NERs – soil residues, non-extractable residues). Different classification systems exist for NERs (e.g. strongly sorbed and chemically bound residues are relatively easy to distinguish from bound residues, which are not distinctly related to a chemical compound (e.g. bound to the soil). The identification and quantification of NERs is of high importance in the context of socio-economic analysis under REACH and the Biocides Products Regulation (BPR). It also provides a tool for further research needs and for addressing the limitations identified in the current testing guidelines. The main outcome of the project will be presented at the SETAC meeting.

434 Elucidation of the nature of soil bound non-extractable residues

M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; F. Schmidt, C. Leake, Bayer AG

Non-extractable residues (NER) can be considered as a combination of plant protection products and NER, both being non-extractable. The method relies on the determination of natural amino acids as the main 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 applicability, limitations and potential technical challenges of those extraction methodologies will be discussed. Preliminary results have already indicated that a further research on the soil matrix destabilising and destroying procedures is necessary to determine at least this fraction for an adequate risk assessment. Other types encompass residues which are covalently bound to the soil and those residues where the test substance or its breakdown products were incorporated into the biomolecules. These residues are considered to be irreversibly bound to the soil or transformed into biomass and therefore no risk for the environment can be anticipated from these fractions. The comprehensive scientific assessment of this classification and the analytical accessibility of these NER types will be discussed and supported by experimental data. Therefore, incubation experiments were conducted following the OECD 307 test guidelines, which allows a mass balance of the spiked residues. The NERs could not be characterised standardised soils were used and with acetaminophen, trioxil and fenouxycar, three radiolabelled test compounds were selected representing a pharmaceutical, a biocide and a pesticide. The substances are already well described with regard to their degradation kinetics and the formation of different NER types. Different mild to harsh extraction procedures like shake flask extraction and a pressurised liquid solvent extraction are comprehensively discussed. Furthermore, different soil matrix destabilising and destroying procedures are evaluated in order to characterize the four NER types proposed by Eschenbach et al. [2]. Finally, a refined extraction scheme shall be proposed with respect to the general applicability for an adequate risk assessment of NER. [1] Kastner et al. 2014. Classification and Modelling of Nonextractable Residue (NER) Formation of Xenobiotics. In Soil – A Synthesis. Celutki. One type of ExxonMobil technologies, 44:19, 2107-2171. [2] Eschenbach et al. 2013. Sequential extraction procedures to characterize non-extractable residues (NER) 2013, Poster at SETAC 2013, Glasgow.

435 A tool to establish the role of Non-Extractable Residues (NER) in soil on toxicity

J. Harnsen, Wageningen Environmental Research / CALM; D. Hennecke,
C. Czau, 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 nucleus 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. We considered an example from sustainable mining, as well as for educational purposes, to provide knowledge and reduce the need to measure the sustainability through the link between anthropogenic activity and global challenges, 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 different 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 efficiently address this challenging 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 Evaluation II (PROMETHEE-II) MCDM method is employed for prioritizing the most sustainable pavements 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
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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

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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 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 both research and decision making process. However, for the current large space industry, the number of products and processes is too high and diverse 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 the space sector, creating the first set of LCA guidelines for space systems in 2016 and now is working to integrate 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 three pillars of sustainability (environment, society, economy) to be addressed within one assessment. 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 approach 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

How can Agent-based Modeling improve decision making in Life Cycle Assessment? For the life cycle of a product, it is essential to know the different environmental impacts of a certain design and to choose the most advantageous. LCA and Agent Based Modeling (ABM) are computational models for complex systems simulation. ABM is a bottom-up approach in which agents interacting between them can be defined, driven by behavior established on simple rules. Coupling ABM with LCA has a high potential to supplement LCA in some of its methodological weaknesses for better decision support. We carried out a literature review of papers combining LCA and ABM based on a set of criteria in order to understand to what extent can ABM enhance LCA at different stages. This review suggests that ABM has the capacity to (a) measure phenomena not only driven by economic or rational factors and (b) forecast emerging dynamics not analytically predictable. Therefore, coupling LCA and ABM is a promising approach to guide the design of products exhibiting dynamics mainly driven by human behavior and to support consequential analysis through its capacity to explore the effectiveness of different sustainable policy scenario. Coupling ABM&LCA can be done with different strategies (extension of LCA, hybrid analysis and complementary use) depending on the expected trade-off between consistency and flexibility. Hybrid analysis is adapted to most of situation since both methods can exchange data externally without impacting the other one. Extension of LCA with ABM leads to a consistent model in which LCA is embedded in ABM, which is particularly relevant for studying requiring to take into account dynamic effects in the technosphere. Different simulations of coupling (hard-coupling, soft-coupling and hybrid) are defined according to (a)data flow direction and (b)coupling dynamic. Higher the degree of coupling, higher the computational time; therefore the use of hard-coupling should be limited to studies integrating feedback in adaptive decision-making process. This paper addresses some methodological guidelines on the way of creating a dynamic LCA based on the inventory phase. Future research in this field should now address temporal dynamics in the life cycle impact assessment.

Environmental risk assessment and management of the material produced in tunnelling excavation

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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 resources, including costs, that, in some cases, will dramatically impair the feasibility of civil work realization. In this paper the legislation framework of Italy, United Kingdom and France, regarding management of ESR is presented and compared, with attention to the characterization protocol used to distinguish waste from by-product. Moreover, some Italian and international case studies will be presented showing validated data, courtesy provided by important construction companies. Case studies will include information on management model of ESR, adopted treatments before final use (considered as normal industrial practice) and final destination. Different approaches clearly appear from this study: in the Northern part of Italy authorities have allowed to use the ESR as by-products while in the area of Rome management as waste prevails. Other cases such as Crossrail (the railway tunnel crossing London), Citriyningen, (Copenhagen underground) and Le Grand Paris (Paris metro) will be discussed. The new circular economy package of the European Commission will push all the member states to move from linear to circular economy with consequent reduction of natural resource exploitation. ESR can be one of the important sector where the challenging objectives may be reached. Now in Europe does not exist a clear understanding of the legislative measures and technical rules needed to harmonize the ESR management. Protocols are needed for their characterization, including biodata, 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, CRITICALITY AND FUTURE PERSPECTIVES

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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 neglect 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.

SETAC Europe 28th Annual Meeting Abstract Book
The increasing use of Earth Pressure Balanced Shields (EPB-TBM) 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 generated during excavation processes can be re-used, except for 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.

**447** Mineral-based soil conditioner for EPB TBMs: An environmentally friendly alternative

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A novel product, based on a natural mineral has been developed for use as a foaming agent and soil conditioning agent with earth pressure balance (EPB) tunnel boring machines (TBMs). It is available as ready 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 ecological tests performed on this material have demonstrated low risk to arthropods, earthworms and soil bacteria. In a recent study commissioned with an environmental consultancy, it was considered that excavated soil, conditioned with the product and deposited in a licenced waste facility 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. A recent independent laboratory have demonstrated the 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 major component of this new product is a naturally occurring mineral with desirable physical and chemical properties which enables it to be used as a conditioner for spoil generated during tunnelling. The physical characteristics and chemical composition of this material have been specifically determined to ensure it was suitable for use in the tunnelling process and will not pose a risk to human health. During the design phase of the project, it is therefore essential the development of a site-specific conditioning study for the management of excavation material. In fact, on the basis of the results obtained from the conditioning using tests, it is possible to hypothesise a maximum dose of the required conditioning agents, which will constitute the reference for the environmental risk assessment in the context of a sustainable management of spoil materials. Anyway, the management of spoil materials produced by excavation from EPB-TBM is extremely complex and is based on numerous design assumptions, characterized by high levels of uncertainty: from the definition of the commercial products to be used and the most suitable soil conditioning parameters, to the execution of analysis and tests to be performed (biodegradation and/or ecotoxicological), up to the methods of interpreting the results. The uncertainties connected to the experiments carried out during the design phase can be reflected in: differences in the operational protocols to be adopted during construction, unavailability of the approved project, consequent increase in time and costs to reiterate the site-specific experiments and the following approval process. The environmental legislation on this field, clarifies only partially how to control and manage the substances contained in foaming agents and additives used for the excavation process by EPB-TBM. To overcome the design problem related to the interpretation or absence of regulatory reference limit values for the main substances contained in the additives, site-specific experiments were carried out in some projects, aimed at evaluating the eco-compatibility of the conditioned soils through biodegradation and ecotoxicological studies of the foaming agents.

**445** Environmental effect of chemicals injected into the soil in mechanized tunnelling applications

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In recent years the management of the soils and rocks resulting from the mechanized tunnel excavation process, raised increasing concern in Europe. The need to manage the amount of conditioned soils generated by tunnelling activities has lead companies, governments and research groups to face economical, technical, logistical and environmental issues. The most widely used technique in mechanized tunnelling, named Earth Pressure Balance (EPB), requires the continuous injection of chemicals during the advancement of the machines to enhance the excavation activity. Depending on the excavated materials features, vapors or foams are generated which are technically feasible for the material re-utilization as aggregate for concrete, for filling in civil engineering, fits for road, railway embankments or breakwater harbour dam, stabilization of slopes affected by landslide phenomena or through projects of landscape management. The lack of information about the environmental impact of these chemicals, introduced during the tunnelling process, may lead to remarkable economical impact of the spoil management, and to the necessity to foresee the proper management of the treated material. In the worst case, the uncontrolled chemical injection could lead to the production of several tons of hazardous waste, whose management might be significantly onerous in terms of cost and time. The University of Rome Sapienza and Astaldi started a joint research program with the aim of acquiring knowledge, data and expertise in the use of chemicals currently used in the soil conditioning processes. This research program has led inevitably to deal with the environmental impact of different products. Preliminary experimental studies started to be performed, a large number of different product were considered, preliminary screenings on the chemical structure and properties of each compounds has been necessary and the physical and chemical features of pure products and their modifications were determined. The major component of this new product is 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, conditioned with the product and deposited in a licenced waste facility 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. A recent independent laboratory have demonstrated the 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.

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

**448** Quantification of Carbon Nanotubes in Complex Matrices: Possibilities of Electron Microscopy

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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. Our high-performance laboratory has demonstrated a unique shape of the CNTs to quantify these materials in complex matrices. Multiwalled CNTs (IRMM 382) suspended in either ultrahigh quality (UHQ) water or in soil
449 Monitoring for perfluorinated compounds, insecticides, and brominated flame retardants in the water of Daechung lake and Geum river basin

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A multi-residue 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 19.7 ~ 135.0 % (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, 3.0 ~ 3.7 ng/L, and 5.1 ~ 11.7 ng/L, respectively while limit of quantification (LOQs) were 0.9 ~ 21.2 ng/L (Insecticides), 2.5 ~ 5.4 ng/L (PFCs), and 15.4 ~ 35.0 ng/L (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, Juwon stream, and Daechung Lake (Dam) every month (March to December) utilizing the developed method. The compounds of the highest detection frequency were PFOA, PFHxA, 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

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4Reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water resources, evaporation and recycling of water can be used as sustainable means to meet the needs of citizens, industries, and agriculture. The use of recycled water for agriculture comes with the potential risk of environmental and food contamination by contaminants of emerging concern (CECs). These compounds pose a potential threat to the health of ecosystems because they are designed to be biologically active at low concentrations and are considered “pseudo-persistent” due to their resistance to degradation and persistence in the environment. The use of reclaimed water for agriculture poses a potential threat of emerging contaminants to the environment, especially in areas where recycled water is being used for irrigation. The potential for these contaminants to enter the food chain and pose a risk to human and animal health is of concern. In this study, we evaluated the potential for selected CECs to be present in reclaimed water used for agricultural purposes. A total of 12 CECs were analyzed for their presence in reclaimed water samples collected from four Southern California water treatment plants. The results of this study indicate that reclaimed water may be a source of potential contamination to the environment and human health. This study highlights the need for further research to determine the impact of reclaimed water on terrestrial ecosystems.

451 Occurrence of pharmaceuticals and their metabolites in Euthynnus alletteratus bile


The accumulation and fate of pharmaceuticals in surface water 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, Catalonia, Spain was chosen as a representative area due to the high concentration levels found in previous studies. 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.
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

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This study was focused on a root uptake of carbamazepine, atenolol and sulfamethoxazole from 3 soils: Haplic Chernozem, Haplic Cambisol and Arenosol Epiftic. 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 (rectilinear dry-mass of soil). The type of tested plants was the same for 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

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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 exposed in the environment to pharmaceuticals via exchanges from wastewater treatment plants. The Non-Steroidal Anti-inflammator 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 effects of human 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, highlighting the effective concentrations for the level exposures, due in part to considerable inter-individual variation in plasma PGE2: 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 concentration of co-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

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Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/455700/2002) 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. Biological data of owner protected data sets were screened and the data sets are normally 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 or 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 could replace long-term by acute data couples. Further changed the assessment factors as applied usually for chemicals without any specific mode of action will be analyzed.

456 Prioritising human health risk of environmental residues of pharmaceuticals and personal care products in use in southern Nigeria

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Pharmaceutical and personal care products (PPCPs) are used worldwide for medical treatment and personal hygiene. PPCP residues are usually discharged into the environment during wastewater treatment. The environmental fate of these chemicals is poorly understood, leading to concerns about potential health effects and ecological impact posed by their use and release. In many developing countries, information regarding the consumption patterns of PPCPs is often limited, even though consumer product usage data are crucial for more realistic exposure estimates, e.g. for risk assessment. To overcome this issue, the following study was performed to estimate PPCP use in Nigerian households to prioritise the potential for PPCPs to enter source water. Using questionnaires as the survey instrument, we elicited information from 350 participants, concerning the most frequently used PPCPs, duration and amount of use in households. Drug usage was limited to over-the-counter(OTC) medicines and was estimated by application of the Household Health Organisation (HHO) daily dosage model. The consumption of personal care products (PCPs) was calculated by multiplying the quantity of products used by the frequency of use. To prioritise PPCPs, a risk index was developed to rank chemicals according to their potential to enter source water. Consumption of PPCPs varied considerably. Analgesics were the most consumed OTC medicines and highest use was observed for paracetamol. Household cleaning products were the most consumed PCPs and highest use was observed for detergent powders. Further, 12 PPCPs were identified as having the greatest potential to impact source water and pose adverse effects to human health. These include 8 active pharmaceutical ingredients (acetaminophen, tetracycline, ...
ciprofloxacin, ampicillin, cloxacillin, sulfamethoxazole, trimethoprim and pseudomorphine) and 4 PCP ingredients (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thioglycolate 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

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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 alga Raphidiocelis subcapitata.

Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative Joint Undertaking (JU) established between EPO and the EEA member states under 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 behavioral profiles in zebrafish embryos and larvae

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Neurotoxic pharmaceuticals are of growing concern as aquatic contaminants due to environmental and human health risks. Even low concentrations can interfere with molecular pathways and population-relevant behaviors. At the same time there is no EU regulatory framework for environmental neurotoxicity assessment. This project aimed to contribute for establishing a neurotoxicity testing approach by integrating molecular (transcriptomics) and functional tests into a new iPES grant agreement framework.

Little is known about the effects at cellular, tissue and individual levels of emergent contaminants such as fullerene C60; in particular, the mechanisms of action are poorly investigated. In this research, 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 signals to regulate cell growth. mTOR activity is modulated 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 iPES project (IM grant no.115735—iPES). Those 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 (BBSRC/NECRI 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 gill 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

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Little is known about the effects at cellular, tissue and individual levels of emergent contaminants such as fullerene C60; in particular, the mechanisms of action are poorly investigated. In this research, 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 actin cytoskeleton reorganization. Mussels were exposed to C60 (0.01, 0.1 and 1 mg/L) for 72h. Tissue C60 accumulation was evaluated by immunofluorescence using a specific primary antibody as well as by high performance liquid chromatography, which revealed 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 revealed by the reduction of lysosomal membrane stability and the enhancement of lysosomal/cytoplasmic 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-shaped 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...
461 Protopic responses to nanoparticulate and ionic silver in freshwater microbes with different background

D. Barros, Universidade do Minho / Centre of Molecular and Environmental Biology, Department of Biology; A. Pradhan, University of Minho / Department of Biology; P.M. Santos, C. Pascoal, F. Cassio, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology. Enhanced use of AgNPs by microbes (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 EC<sub>20</sub> (effective concentration) were assessed based on the variations in the overall proteome in two 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 a slow increase in AgNP 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<sup>+</sup> 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<sup>+</sup> 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<sup>+</sup> was higher (68%) indicating different responses to Ag<sup>+</sup> and/or AgNPs. In At72, Ag<sup>+</sup> 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 used to get a mechanistic insight on the stress induced by AgNPs and/or Ag<sup>+</sup> 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

F. de Queiroz, University of São Paulo / Instituto de Biociências e Ciências Exatas; J. Sturve, Göteborg 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 increasing. This has raised serious 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 destruents, primary producers and fish, a panel of seven well characterized (with different size, coating and charge), biocide free, 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 (m<sup>2</sup>/L) against the observed toxicity. The results show that gill cell lines were the most sensitive test model with the lowest reported EC<sub>20</sub> 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 (TiO<sub>2</sub>-ENP) are extensively employed in manufacturing of cosmetics, pharmaceuticals and health care products. As a result, TiO<sub>2</sub>-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 TiO<sub>2</sub>-ENP are gaining prominence across the globe. In the backdrop of assessment toxicity of rutile TiO<sub>2</sub>-ENP (r-TiO<sub>2</sub>-ENP) in soil sentinel, present study is aimed at evaluating their toxicity as per OECD-207 guidelines on earthworm, Eisenia fetida. Physicochemical characterization of r-TiO<sub>2</sub>-ENP using dynamic light scattering revealed their tendency to form agglomerates (330-480 d.nm) in water. Soil exposure of earthworms to r-TiO<sub>2</sub>-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, superoxide dismutase and glutathione peroxidase as well as lipid peroxidation index indicate the potential of r-TiO<sub>2</sub>-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. Hackenberger, Departement f Biology, University of Osijek / Department of Biology; T. Lonnarphi, University of Osijek / Department of Biology; D. Marković, University of Rijeka / Department of Biotechnology; I. Obdži, Rudjer Boskovic Institute; B. Hackenberger, Departement f Biology, University of Osijek / Department of Biology. When assessing the toxicity of pesticides and other chemicals to non-target organisms the most common experimental set-up is an exposure to a single compound. However, it is more likely for organisms under the environmental exposure to combine metabolites that have different modes of action and potentially can interact with each other. The aim of this research was to investigate the effects of a mixture of ZnO and chlorpyriphos (CHP) on biochemical biomarkers and reproductive success of the earthworm Dendrobaena veneta with possible differences in effects of ZnO in nano and bulk form, and the difference of effects in various soils. EC<sub>50</sub> values for reproduction of D. veneta after exposure to CHP and ZnO were calculated and used in the binary toxicity experiment. Concentrations were as follows, with EC50 being 100%: 100% CHP, 75% CHP/25% ZnO, 50% CHP/50% ZnO, 25% CHP/75% ZnO, 100% ZnO. ZnO was separately tested as bulk and nano sized particles and CHP was tested as a commercial preparations. The entire experiment was conducted according to the OECD earthworm reproduction test. At the end of the experiment the number of juveniles and activities of AChE, CAT, GST, TBARS, MT and PC were measured. The concentrations of pesticides in soil samples were measured with UPLC and the concentrations of Zn was measured with the energy dispersive x-ray fluorescence technique (EDXR). CHP had a clear effect on AChE activity with almost 50% inhibition after 28 days of exposure in artificial soil. CAT activity did not change on any concentration, for both ZnO and ZnO<sub>n</sub>, while GST activity decreased. The number of juveniles was significantly reduced with all mixture ratios. In natural soil CAT activity was also unaffected with bZn, and slightly induced with ZnO/CCHP combination. The inhibition of AChE was present at all applied combinations. In natural soil the number of juveniles was reduced with nZnO, while it remained the same as control after bZnO exposure. The effects of combined exposure of CHP and ZnO was dependent on the form of ZnO, and activity was greatest in the characterized soil which had the risk of earthworms being exposed. More biomarkers should be employed to elucidate which low-level biomarker can be linked with the effects on the higher (reproductive) level.

465 Poster spotlight: WE305, WE323, WE324

Improving the environmental risk assessment of the aquaculture 'Blue Revolution'

466 Tools for Assessment and Planning of Aquaculture Sustainability (TAPAS)

P. van den Brink, Alterra and Wageningen University; A. Lillcrap, NIVA Norwegian Institute for Water Research / Ecotoxicology; A.L. Macken, Norwegian Institute for Water Research, NIVA; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T.C. Telfer, University of Stirling Aquaculture is a major food production sector which will play a major role in filling the growing seafood supply gap, estimated to be of the order of 47.5 million tons by 2050. However, aquaculture cannot be practiced everywhere; it requires a particular set of natural, social and economic resources which must be used wisely if the development of the sector is to be sustainable. Appropriate environmental characteristics, good water quality, well-understood social interactions and use of inland and coastal resources are essential to maintaining in existing and future aquaculture systems. Consequently, suitable zoning, selection of sites and application of carrying capacity are among the most important issues for the future success of European aquaculture, and also predicate the need for sustainability, resilience and best practice guidelines, as provided by the Ecosystem Approach to Aquaculture. The four-year Horizon 2020 TAPAS research project, which started in March 2016, aims to consolidate the environmental sustainability of European
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

L. Liu, National University of Singapore, Gin, 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 micropolutants (MPs). In this study, the presence and distribution patterns of 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 cyclamide, salicylic acid and sucralose, with concentration range of

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality

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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 in urban and periurban regions with differential waste management capacity. Yet high population densities 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 regions, where many of the megacities will continue to emerge over the next few decades, adoption of chemical products is 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 diffuse 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 for nonionizable organic contaminants. In North America we are examining intersections among water reuse practices and aquaculture for various products. Such efforts appear warranted at the global scale.

469 Bioaccumulation of selected veterinary medicines in the blue mussel (Mytilus edulis)

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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 teflubenzuron, emamectin, deltamethrin and azamethiphos. Due to the low solubility of teflubenzuron 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 teflubenzuron was also assessed. As some other mussels in brackish waters show different bioaccumulation dynamics. So far, the results have shown a clear uptake of teflubenzuron over 14 days, reaching maximum concentrations (~1500 ng/g) after 10 days. Depuration of teflubenzuron 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 teflubenzuron. In contrast, deltamethrin 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.

470 Contribution of nuclear applications to better understand bioaccumulation of contaminants in aquaculture species

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Environmental pollution from aquaculture is often seen as a major concern, but today, increasingly is the potential exposure of aquaculture to contaminants. In order to fully understand the contamination risk of farm-raised species, nuclear applications can be used. The development of powerful tools is relevant in the face of the susceptibility of economically important species (fish and seafood) to be contaminated. Marine fish farming is regarded as the future of aquaculture and thus, the safety of these farm-raised fish is paramount particularly as 50 % of fish consumed are now farm-raised. Therefore, a better understanding bioaccumulation processes of such contaminants with current aquafarming practices is essential. Such work will attempt to better understand the role the fish food or key environmental parameters on contamination of fish that may affect the health of the farmed species and/or the human consumer. This has been commonly done in a natural setting but is now beginning to be examined for fish farming practices. Major advantages of radiotracer techniques over conventional techniques are their very high sensitivity and discrimination capacity: it permits the measurement of bioaccumulation kinetics of several elements at realistic (viz. low) environmental concentrations in a single experiment. Furthermore, some radiotracer permits the non-destructive analyses of contaminant levels in living organisms. This paper identifies present and future threats on farm-raised fish from a contamination point of view, and presents a synthesis of experimental results completed on farm-raised fish farming. The exposure assessment of food, water salinity and temperature can have on the Assimilation efficiencies of trace elements and radionuclides in farmed fish. Such findings paving the way for further investigations on the potential use of nuclear techniques in aquaculture and food safety.

471 Effects of antibiotic’s medicated fish feed in the marine environment

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Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics used in aquaculture have been reported to accumulate on sediments and non target aquatic organisms, modifying the biodiversity and the environmental conditions in areas close to fish farms. Moreover, recent studies showed the presence of resistance genes in environmental bacteria next to fish farms, which indicates the assembly, selection and dissemination of antimicrobial resistance through open aquaculture installations and might thereby compromise environmental and human health. A field experiment was performed in a moderately impacted bay in the south east coast of Spain (Aguilas, Murcia), which consisted of a series of sediment traps (covered with a net vs. uncovered) filled with local sediment and fish feed; non medicated or medicated with three antibiotics (oxytetracycline, florfenicol and flumequine). Fish feeds were applied simulating fish farm loses for a period of 3 weeks. Measured antibiotic concentrations in the sediment were 2700 – 8000 ng/g (average 1% of the applied amount) for oxytetracycline, and 19000 – 54000 ng/g (average 10% of applied amount) for flumequine. Florfenicol was not detected. Different accumulation rates were found in covered/uncovered traps due to wild fish influences in the availability of feed and bioturbation. Physico-chemical characteristics of the sediment also changed; with a higher S and lower N content and a larger percentage of fine material in feed affected treatments. Invertebrate
presence was also correlated with the food availability, although no evident effects of the antibiotics were found over the analyzed samples. Bioaccumulation of the target antibiotics in the invertebrate community and evaluation of the antibiotic impacts over the microbiome and resistome of the sediment bacteria is still ongoing. This is one of the first studies describing fish feed and antibiotic impacts produced by aquaculture under Mediterranean conditions.

**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 humans 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 cardiotoxicity 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, citalopram, 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
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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 avoiding focusing on gene expression patterns that are the cause of clonal or interindividual variation. Furthermore, most studies select an arbitrary timepoint to measure gene expression or transcriptome expression 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?
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Microalgae (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 rise 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 microalgae. We selected the unicellular microalgae *Scenedesmus vacuolatus* to triclofen were exposed 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 items (metabolites/transcripts) and we build concentration response 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 triclofen 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. Then, the 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 metallohydrones and endocrine disruptors
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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 environmental toxicology approaches/protocols are based on chemicals mixture 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 (AChE inhibitors) or Cd, whereas some of the estrogen disruptors, has already been shown to play a role with the estrogen receptor in humans but its role in *Daphnia* is still under surveillance. To further study this finding we exposed *D. magna* to complex mixtures of Cd and ethinylestradiol. While the individual exposures triggered the alteration of expression of a relatively large number of genes, the exposure to the mixture showed little or no effect. These results indicated that both compounds share a complex interaction at a molecular level suggesting that the degree of conservation of the regulatory pathways underlying response to endocrine disruptors may be higher than previously thought. Overall, our work shows that it is possible to predict a compound MoA from its...
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. Eoekema, Wageningen IMARES; R. van der Oost, Waternet / Onderzoek en Advies; K. Chipman, University of Birmingham; F. Falciani, 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. Watermonarica 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 only one 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, in 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. Degli Esposti, J. Legler, University of Birmingham / School of Biosciences; C. Ajao, ECHA, Sense About Science EU

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. Vanheeswijk, 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 engagement, 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
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 stress

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturase and elongase transcriptomes of fathead minnow

489 The effect of water chemistry on cadmium induced olfactory impairment in juvenile rainbow trout (Oncorhynchus mykiss)

Ecolological 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 computing 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 desaturase and elongase transcriptomes of fathead minnow

M. Fadhlaoui, INRS - Eau, Terre et Environnement / Centre Eau Terre Environnement; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; P. Coulou, 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 (fad2, degs2, scd2) and elongases (elovl5, elovl6, elovl8). 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, the 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. Unexpectedly, 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 not in the same direction as for yellow perch. We observed a mismatch between desaturase and elongase 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. Voitz, RWTH Aachen University / Department of Ecosystem Analysis; S. Bogart, A. Macdonald Wilson, University of Lethbridge / Department of Biological Sciences; H. Hollett, RWTH Aachen University / Centre Eau Terre Environnement; G.G. Pyle, University of Lethbridge / Biological Sciences

Fish are dependent on olfaction since a variety of essential behaviours, 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 warm water chemistry on cadmium induced odour perception 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) concentrations 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 amendments ameliorated 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 risk to the primary olfactory system. Metals can also affect other olfactory processes, such as the binding dynamics at the olfactory epithelium, the development of the olfactory system and the olfactory learning. This presentation will look at regulatory science communication by 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.
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 parameterized 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 affinity constants and maximal binding capacities.

490 Physiological and biochemical responses of polychaetes: interplay of elements contaminated sediments and salinity changes

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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 determine the impact of metal contamination on marine communities, 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), behavior (burrowing tests with Hediste diversicolor and Arenicola marina) and biochemical responses: indicators of cell damage (LPO), antioxidant (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 and A. 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 to salinity 21 and 40 led to a decrease of burrowing kinetics 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?

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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 as 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 with bioturbators fitness and therefore modify their influence on 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 exposition. 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

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Global environmental change is driven by multiple anthropogenic stressors. Conservation and restoration requires understanding the individual and joint action of stressors to evaluate and prioritize 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 by 1) 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 approaches on how to apply them on multiple stressor scenarios. Moving forward, future research 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

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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 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

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Asking factors for low tier aquatic bioassays (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 and endpoints for calibrating limit values for assessment factors based on different-field 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 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.

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The unforeseen consequences for animal welfare of the OECD TG 240 (MEG0RT) biological validity criteria
E. Salinas, BASF SE / Eperimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology
The MEG0RT Extended Observation Reproduction Test (MEG0RT) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MEG0RT 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 MEG0RT 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. However, data as is currently few laboratories can implement this highly complex TG. The MEG0RT 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 MEG0RT 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 MEG0RT fecundity validity criterion 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 MEG0RT. 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.

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Variability in Non-Target Terrestrial Plant Studies Should Inform Endpoint Selection
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Inherent variability in Non-Target Terrestrial Plant (NTTP) guideline testing of pesticide establishes challenges 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 MEG0RT. 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.

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An avian reproduction study historical control database: A tool for data interpretation
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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, as well as the low number of studies available. 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.

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Experimental Design and Model Selection for Ecotox 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 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=β0+β1X, where β1 is the expected mean response in the i th concentration, and the ei are independent random errors, usually assumed to be identically distributed. Which 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, μi. It is 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 ecological 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 (II)

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Integration of Risk Assessment and Life Cycle Assessment in the context of recycling wood waste into particleboard
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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, therefore, recycling of post-consumer wood waste requires special attention to the determination of treatment conditions and whether dust from particleboard mills, for example, may contain high concentrations of heavy metals such as arsenic and copper. Heavy metal toxicity is a threat to the environment and is associated with adverse health effects. In the particleboard industry, heavy metals may be discharged into the air when dust from wood waste is incinerated to supply heat for dryers. Moreover, downstream industrial customers of particleboard (e.g. furniture manufacturers) who import this product can face high dust costs for internal heat supply, are of concern as well. Local human health effects due to reduced local air quality may question the overall benefit of recycling contaminated wood waste
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 Immission 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

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This paper 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 not restricted to) waste circularity, 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 to 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 assessment tool that can address these issues via use of 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

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Existing Life cycle assessment (LCA) studies of biochemicals reveal that there are clearly benefits that need to be overcome in order to reach 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 agro-industrial lignocellulosic, or non-agro-industrial biomass like algae. Macro-algae is one such potential source that given they grow without being farmed, while simultaneously being an important sink for CO2. The objective of this study is to identify trade-offs between assessed environmental impacts and possible burden shifting between macro-algae compared to more conventional feedstocks like maize and lignocellulose. While it is imperative that any change in process configuration reflects in Techno-Economic Assessment (TEA) and LCA, there are very few studies which couples these two assessment demonstrating the trade-offs for improved decision support. The focus of this contribution is to explore methodological overlap between the two assessments and develop a framework, supported by a proof-of-concept. When contrasting current results from the TEA and LCA cradle-to-gate study, some interesting trends were observed. The TEA show that algae are the biggest hotspots identified as feedstock cost which is a function of growing, transportation of biomass and if drying is taking place at the refinery site or closer to the harvesting sites of the feedstock. Whereas, the LCA shows the biggest environmental hot-spots occur in relations to growing of bio-feedstock. This requires external application of nutrients and intensity of chemical pretreatment. Today dozens of new chemicals are further developed companies mostly rely of results from TEAs. Our results that show the methodological overlap between TEA and LCA are of that magnitude that justifies the appraisal of this integrated methodology. Introducing LCA as a decision support tool would integrate sustainability requirements in development of technology and solutions. All technologies and products have a life cycle, and by analyzing their impacts, we put numbers on sustainability and benchmark the solutions.

502 A risk evaluation approach for indirect land use change associated to biobased products

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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 biobased 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 lead to so-called indirect LUC effects. In the best case scenario, a direct land use change associated to biobased 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 assessment tool that can address these issues via use of 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

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The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to find the most sustainable applications in 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 decision making at an early development stage. 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/compareatively. 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 for be achieved for
Multiple lines of evidence for risk assessment of old sea deposits for ilmenite mine tailings in SW Norway

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An area 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 deposits and reference sites were sampled for studies of macrobenthic communities, biogeochemical 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 basin deposit 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 outer basin deposit. Ammonium (NH₄) and organic carbon (OC) concentrations are frequently used to evaluate and predict metal bioavailability in sediments. Where concentrations of bioavailable contaminants are determined to exceed sediment quality guideline levels, bioassays are usually performed to evaluate toxicity 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 moderate reduction of benthic biodiversity at the old deposit sites. [1] Guideline M-608, 2016. Norwegian Environmental Agency. 24 pp.

Environmental Risk Assessment in Sediments

Assessment of risk from historic contaminants in sediments of the Elbe flood plain, using a multiple line of evidence approach

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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 among the most polluted rivers in 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 for long time 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 assessment of risk comprised the thickness of the sediment layer and sediment mobility during flood events. Dating of sediment cores by ²¹⁰Pb analyses facilitated interpretation of the results. Samples were ecotoxicologically tested for inhibitory effects in the bacterial sediment contact test (Arthrobacter globiformis), the luminescence bacteria test (Allivibrio fischeri) with elutriates and methanol extracts and the algae growth inhibition test (Raphidocelis subcapitata) with elutriates. The studies showed that - more than 75 % of all sampled sites were contaminated with heavy metals and organics well beyond the threshold values of the Elbe River Commission. - ecotoxicological effects provided a distinct line of evidence and could be not simply related to analysed 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.

Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS) and toxicological reference the consumption of an average EU citizen in the baseline year 2010. For the calculation of the Consumer footprint, the consumption of European citizens is split into five key areas (food, housing, mobility, household goods and electrical/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 assessment of lifecycle impacts, different scenarios have been developed for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspot 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.

References

2. 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 the normalised DGT metal fluxes and metal toxicity measured in the SWI (DGT filter). Negative adverse effects to reproduction and survival of the amphipod exposed to laboratory conditions. Useful predictions 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 in sediment quality assessments lines of evidence based on in situ evaluations of metal bioavailability.

An Overview of the Refinements and Improvements to the USEPA’s Sediment

SETAC Europe 28th Annual Meeting Abstract Book
Sediment toxicity testing among other ecotoxicologic tests is currently reviewed under the premise to improve quality and consistency of regulatory environmental risk assessment. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on the use of sediment organisms where a water-spiked test system (OECD 219) is considered to study chronic effects on sediment organisms. Prominent test organisms are Chironomids, aquatic insects which live in and on soft sediments. Due to the design of this study initially large gradients between the exposure in the overlying water and in the sediment layer are established. As a consequence, substantial temporal and spatial dynamics of local concentrations have to be expected, especially in the vicinity of the interface between water and sediment where the Chironomids are supposed to stay. To describe local concentrations in such water-sediment test systems we simulated the transport and the redistribution of two moderately mobile (KOC 200 to 300) plant protection products with the mechanistic model TOXSWA. The results of this simulation are compared with measured sediment concentration in three depths (see contribution submitted by Dorn et al.). The compound properties were parameterised using values derived independently in standard tests (KOC, DT50_water/sediment) or from literature (diffusion coefficients). Other parameters were derived from OECD 219 experimental design information. The simulations matched the measured concentrations spatially and temporally well. The simulated concentration depth profiles averaged for the layers which were measured lay almost always within the range of single measurements. Also the concentrations in the overlying water were reproduced well. The main findings are that the concentrations in the sediment show a pronounced temporal pattern and that the concentrations in the sediment are strongly depth-dependent. The dominant transport process in the sediment is obviously diffusion which however did not lead to homogeneous penetrations of the sediment. Presuming that chironomids live in the upper three millimetres of the sediment, they are exposed to approximately four times higher test compound concentration (total and liquid) than the average concentration in the sediment. This has important consequences for the derivation of effect endpoints of chironomids from OECD 219 study data, which should consider the local exposure of the organisms.

Wastewater effluents: How research can improve risk assessment and regulation

511 Effects of untreated wastewater dilution in surface waters on pharmaceuticals natural attenuation and on the community genomics: Implications for ERA
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The increasing 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 (DUW), 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 DUW. 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 attempt to expand this area of study within research. The biodegradation 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 homogeneous penetration of the sediment. Presuming that chironomids live in the upper three millimetres of the sediment, they are exposed to approximately four times higher test compound concentration (total and liquid) than the average concentration in the sediment. This has important consequences for the derivation of effect endpoints of chironomids from OECD 219 study data, which should consider the local exposure of the organisms.

509 Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fluazinid
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In the EFSA scientific opinion on sediments, one of the oligochaete worms Lumbricus spp. or Tubifex tubifex, supplemented with a second standard test species, a visitor or a sand substrate group such as the midge 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 fluazinid-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa available. The most sensitive sediment-dwelling organisms was the oligochaete Dero digita in the test systems used were 1.5L glass vessels containing approximately 2 cm sediment and 1 L aerated spring water. Tests were considered valid if control mortality did not exceed 20% or, in the case of the larvae of the midge C. riparius, if more than 70% emergence had occurred. Fluazinid concentrations were measured at the start and the end of the testing. Endpoints for both worms comprised surviving animals and their weight, including yield and growth rate. For Hyalella both survival, weight and length were assessed, while for Chironomus emergence and total survival was monitored. All tests met the validity criteria of less than 20% control mortality or more than 70% emergence, with the exception of the C. riparius test on artificial sediment. Overall, tests with field-collected sediment gave more sensitive responses. Apparently growth of the animals was better here, allowing for a better expression of effects. Sometimes a factor of 10 difference between the estimated 28d EC₅₀ value and its upper or lower confidence limit was present, indicating a high associated uncertainty. The confidence intervals were considerably smaller in corresponding 28d EC₅₀ values, indicating that the data is more reliable. But lab as the outdoor microcosm testing the most sensitive organism was an oligochaete. In general, biomass reacted more sensitive than length and survival endpoints. Using either field-collected or artificial sediment data to derive a Tier-1 RACₐ₅₀ seems to be sufficiently protective when compared to the outdoor microcosm response.
Wastewater Treatment Works: Measurement, Prediction, Risk - A Cause for Concern?

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This work reports on the ability for wastewater treatment works (WWT-W) to remove active pharmaceutical ingredients (APs), 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 APs of greatest risk of exceeding estimates of their PNEC in receiving waters for all WWT-W in the UK. The majority of substances studied were removed to a high degree, although with significant variation, both within and between WW-TW. Poorer removal (between influent and effluent) was observed for ethinylestradiol, 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 measurements of effluents from 45 WW-TW on 20 occasions). The application of models to predict removal efficiencies are reported. Based on available dilution data as many as 890 WW-TW in the UK (approximately 13% of all WW-TW) may cause exceedances of estimated riverine PNEC 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, and our part of the project focuses on assessing the uncertainty in these factors.

The dataset and discussion, provides information to assist in the future management of these types of chemicals.

513 Impact of a wastewater treatment plant upgrade on amphipods and other macroinvertebrates: individual and community responses

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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. Micropolllutants can cause short- or long-term adverse effects in aquatic organisms even at low concentration levels. One possibility to reduce the input of micropolllutants into the water cycle is the upgrading of WWTWs with an additional purification stage using e.g. ozonation or powdered activated carbon. The current aim with this study was to evaluate the removal of pharmaceuticals in a WWTW, when adding ozonation as an additional tertiary treatment step and also to investigate the environmental impact of this effluent on the receiving river. All treated effluent from a minor WWTW (10000 PE) were treated by an addition of 8 mg h⁻¹ ozone during 6 months. Removal rates in the WWTW as well as levels of pharmaceuticals in the receiving river (both in water and biota) were monitored. Surface water data from 10 sampling sites and 10 sampling occasions before, during and after ozonation, will be presented. Ecological status and levels of pharmaceuticals in exposed biota (n=5) at each site and sampling occasion will also be presented. Several additional methods to evaluate the impact of ozonation was used including impact on microbial community composition, presence of antibiotic resistance genes as well as studies to detect endocrine, reproductive and behavioral effects in fish and its progeny.

515 Dreissena polymorpha as purifier tool of protozoa in wastewater treatment plant effluent

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Aquatic environments are subject to discharges of multiple contaminants (chemical and biological compounds). Wastewater treatment plants (WWTWs) are ineffective to remove environmental forms of protozoa such as Toxoplasma gondii and Cryptosporidium parvum oocysts or Giardia duodenalis cysts because of their resistance to chemical and physical treatments. These protozoa are clearly identified as a public health priority since they are major parasites of waterborne outbreaks. Many studies underline the interest of using of freshwater bivalve Dreissena polymorpha for biomonitoring. Indeed, this bivalve has a huge filtration capacity leading to an accumulation of chemical and biological contaminants in its tissues. The DROPP (The dreissene as purifier tool of protozoa in WWTW effluent) project aims to test the depurative capacity of the zebra mussel in terms of protozoa’s contamination in WWTW effluents. To answer this issue, it’s necessary to determine if D. polymorpha is able to live in good health in the multi-contaminated conditions in WWTWs effluent and D. polymorpha is able under these conditions, to bioaccumulate protozoa. For this purpose, two experiments were performed: 1- Zebra mussels were caged in the WWTW’s outlet (River Charleville-Mézières, France) for 28 days. We studied morphometric parameters, filtration capacity, energetic reserves, enzymes related to oxidative stress (Superoxide dismutate, Catalase, Gluthathione S-Transferase and Gluthathione Peroxidases) at biochemical and molecular levels. The results suggest that D. polymorpha can maintain itself in effluent for 21 days. 2- D. polymorpha was exposed to different concentrations of protozoa (100, 1000 and 10000 protozoa per bivalve per day) for 21 days followed by 21 days of depuration in laboratory conditions. Detection of oocysts and cysts in tissues and haemolymph of bivalves was carried out by molecular biology techniques. The results highlight a time-dependent and dose-dependent bioaccumulation of protozoa by D. polymorpha. Moreover, the parasite load remains stable during the 21 days of depuration, suggesting that the zebra mussels could be used as a promising tool for protozoa depuration. Keys words: protozoa, wastewater treatment plant, bivalve, depuration

516 Aquatic macrophytes potential for the removal of water contaminants - The Green Liver Application

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Reservoirs are aquatic environments that are impacted by anthropogenic activities. The main activities around reservoirs in Brazil are agriculture and settlement. Agriculture and increase of nutrients can result in cyanobacterial blooms and cyanotoxins contamination; and settlements can result in inputs of several contaminants such as pharmaceuticals. Iraí Reservoir, located in South of Brazil, is...
used to water supply and has been reported as contaminated by cyanotoxins 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 Green Liver System 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 patocetamol, diclofenac and microcystin-LR using a laboratory model of the Green Liver System 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 Green Liver System 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**

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Releases of antimicrobials into the environment increase selective pressures on environmental microbes contributing to the proliferation of antimicrobial resistance (AMR) and perhaps the inevitable ‘post antibiotic era’. One of many challenges in understanding environmental AMR is the high cost and organization 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**

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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 this rapid emergence continues to be debated. It is known that soil pollution is inherently linked to co-selection for ARGs yet limited information exists on large scale, multi-contaminated soils. This study in 24 locations across the North East of England to evaluate AMR in urban and rural soils with high and low pollution levels. We present pioneering high-capacity quantitative PCR profiles of 230+ antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs). The project has coupled ARGs and MGEs to comprehensive geochemical datasets including 12 metals (total and bioavailable), 16 PAHs, and nutrient conditions to understand the evolution and dissemination of modern antibiotic resistance due to pollution.

**519 Dissemination of extending-spectra β-lactamase E. coli carrying multidrug resistance and virulence factors in tropical rivers receiving hospital effluents**

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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), these studies are available 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 treatments. Additionally, there is an increasing occurrence 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 issued along 5 rivers receiving hospital effluents. They were analysed for their clonality and the co-occurrence 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 generation, ST1, ST21, ST162, ST258 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, tetracycline, quinolones and phenicol classes) and may also carry virulence genes factors. The proliferation of multi-drug resistant *E. coli* are not only linked to treated 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 in aquaculture 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 be used to track selective endpoints. 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 standardised 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.

### Determining the minimal selective concentrations of macrolides in a complex microbial community

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Antibiotic resistant bacteria are released into natural environment from many sources. Continuous release of antibiotics from human activity can and does lead to measurable concentrations in surface waters (ng/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 macrolide concentrations. QPCR determined the presence of a variety of macrolide resistance genes (ermA,ermB,msrD and mef [family]A and B) 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 ermA gene shows a selective response at the lowest concentration for all three macrolide antibiotics. No significant selection is seen for ermA at 50µg/L, but we do see significant selection at 750µg/L 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.

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**Do nanoparticles cause stress effects on microalgae? An infrared spectroscopy study.**

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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, chloramphenicol and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 mg kg 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 on solid growth media containing various antibiotics. Genes encoding resistance to many classes of antibiotics including the sulphonamides, 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.

### 523 Inter-annual monitoring of microplastics in marine intertidal sediments of the Firth of Forth

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Microplastics (MP) are defined as plastic particles 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 contamination prevention, as well as the limitations. Sediment samples were obtained in triplicate from intertidal sites in May2014, May & Sept2015, May & Sept2016, 2017 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 plastic 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 microplastic contamination issue, more standardized sampling and extraction procedures need to be developed.

### Ecotoxicological evaluation of high-generation cationic PAMAM dendrimers towards a representative organism of aquatic ecosystems

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Nowadays, nanomaterials are extensively used worldwide in many different fields and their potentially serious effects in aquatic ecosystems have become a global concern [1]. Poly(amidoamine) (PAMAM) dendrimers are polymeric nanoparticles that have a typically symmetric core, an inner shell, and an outer shell. Due to these characteristics, their use is being tested in the implementation of targeted therapies in biomedicine so that they might end up in environment [2]. In this study, we have investigated the effect of high-generation cationic G5-NH₃⁺ and G7-NH₃⁺ PAMAM dendrimers in a prokaryotic primary producer of aquatic ecosystems, the filamentous cyanobacterium *Anabaena* sp. PCC7120 (*Anabaena*). Dendrimers significantly decreased the growth of the cyanobacterium and both dendrimers induced morphological alterations of both filamentous and individual cells. Furthermore, cyanobacteria exposure to dendrimers resulted in significant alteration of physiological parameters: increase in the concentration of intracellular reactive oxygen species, damage in membrane integrity, membrane potential depolarization, increase of metabolic activity, acidification of intracellular pH and alteration of intracellular free Ca²⁺ homeostasis. Dendrimers also induced alterations in the photosynthetic responses of *Anabaena*. In conclusion, high-generation cationic dendrimers exhibited high toxicity towards

526 Interactions of carbon nanoparticles and benzo(a)pyrene on marine mussels, Mytilus galloprovincialis A. Barranger, University of Plymouth / School of Biological Sciences; Y. Aminot, University of Plymouth; M. Banni, Laboratory of Biochemical and Environmental Toxicology; S. Storzini, Universita Del Piemonte Orientale Amadeo Avogadro / Department of Sciences and Technological Innovation (DiSIT); V. M. Aftl, Kings College London / School of Chemistry; A. Kholybovy, University of Nottingham / School of Chemistry; A. Viarengo, University of Piemonte Orientale / Department of Sciences and Technological Innovation DiSIT; 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), aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polymeric aromatic hydrocarbons (PAHs) can interact with each other to differentially modify their pot additive toxicity. To probe this hypothesis, marine mussels were exposed for 3 days to benzo(a)pyrene and two different types of carbon nanoparticles, [C60 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 GC/MS. 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 microarrays targeting 15 stress response pathways. Contrasting results were obtained as Gaing to the use of carbon nanoparticles used. Co-exposure of mussels to MWNNTs and BaP seems to reduce the uptake and genotoxic effects of BaP in the digestive gland. Conversely, co-exposure to C60 and BaP does not seem to affect the uptake and genotoxic effects 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) and cellular and molecular parameters were quantified in order to assess CNP and BaP effects to marine mussels on cellular and molecular levels. However, the detected changes were low and did not show a clear concentration-dependent pattern. The genotoxicity of CNPs in mussels is still unknown, and this study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

527 Transferrin binding of CuO Nanoparticles 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 Catholique de Louvain / University of Louvain; A. Baun, Technical University of Denmark / DTU Environment; J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences; H. Selek, Roskilde University / Dept Science and Environment Nanoparticles (NPs) will inevitably end up in the aquatic environment, where they will settle out and accumulate in the sediment. Therefore benthic fauna is at risk of being exposed to CuO ENP, which may affect behavior) or whether the avoidance behavior may have protected 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 two different types of benthic organisms: Corbicula fluminea and mussels. This research was supported by SETAC Europe 28th Annual Meeting Abstract Book.
complexity: bacterial cells, enzyme reactions, and fluorescent proteins

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Luminescence of living systems is a convenient parameter to monitor environmental toxicity. Luminescent systems of different complexity—luminous marine bacteria, their reactions, and coelenteramide—showing fluorescent proteins (CLM-CFPs) were used as bioassays to monitor toxicity of water solutions under model conditions; toxic effects were compared at cellular, biochemical and protein levels, respectively. Organic compounds, metallic salts, and radioactive elements (under conditions of low-dose irradiation) were applied to vary toxicity of media. Luminescence inhibition (toxic) and activation (adaptive response) effects were evaluated and discussed. Application of CLM-CFPs as toxicity bioassays of a new type is justified, they can serve as a proper tool for study efficiency of primary physicochemical processes in organisms under external exposures. Coelenteramide (CLM), fluorophore of CLM-CFPs, is a photochemically active molecule: it acts as a proton donor in its electron-excited states, generating several forms of different fluorescence state energy and, hence, different fluorescence color, from violet to green. Contributions of the forms to the visible fluorescence depend on the CLM microenvironment in proteins. Hence, CLM-CFPs can serve as fluorescence biomarkers with color differentiation to monitor results of destructive biomolecule exposures. Variations of spectral-luminescence and photochemical properties of CLM-CFPs under different exposures—chemicals, temperature (1), and ionizing radiation—were proposed depending on the reaction conditions. And different complexity for detoxification efficiency evaluation is discussed. Natural and artificial bioactive compounds, humic substances (3) and fullerenols (4), are used as detoxifying agents. Detoxification mechanisms were revealed to be complex, with chemical, biochemical, and cellular aspects conditioning those. Active role of the bioassays systems in the detoxification processes was demonstrated. 1. Aleva R, Kudryashova N, Rozhko T, et al. Appl Biochem. 2017. DOI: 10.1007/s10212-017-0404-9 3. Kudryashova N., Tarasova A. Environ. Sci. Pollut. Res., 2015; 22 (1), 155. 4. Kudryashova N., et al. Photochemistry and Photobiology, 2017; 93(2), 536 S. Sachkova A., et al. Biochemistry and Biophysics Reports. 2017, 9, 1-8

531 Assaying the proxidant and antioxidant potentials of nicotine products: Tobacco versus electronic cigarettes

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Cellular oxidative stress results from imbalance between the production of reactive oxygen species and the efficacy of the antioxidant defense, can be a consequence of using the nicotine products. Proxidant properties of the tobacco smoke are accounted for by the abundance of the smoke oxidants. The antioxidant potential of the smoke is scantily addressed in the literature. However, one should take into account that any reactant in oxidation process may exhibit both oxidant and antioxidant propensities depending on the reaction conditions. And different oxidant have shown that smoke constituents indeed exhibit at the same time both proxidant and antioxidant activities. Such smoke-borne antioxidants may be assessed through both the direct chemiluminescence (CL) derived from the smoke samples as a function of the smoke tar content and using the probe CL preparations of hydrocarbon substrates being oxidized. In addition to exogenous antioxidants derived from the smoke, we have studied the proxidant properties of carbon dioxide generation directly in smokers. For that purpose, we have developed a novel assay based on the CL of luminol, which involves tobacco-smoke extracts, peroxidase and amino acids. Using such a system, we have demonstrated that under physiological conditions the oxidation of the smoke tar and its individual components, e.g. catechol, in the presence of H₂O₂, peroxidase, and glycine affords the products (first of all, catechol-glycine adducts) whose antioxidant potential is much higher than that of initial, unoxidized, chemicals. Conversely, we have not observed any significant antioxidant activity of aerosols derived from electronic cigarettes (ECs). For ECs, the following feature is noteworthy. We have found for the first time that all ECs, regardless of their technical complexity, generate in their emission (from the substrate of their heating) a number of ROI (main component of e-liquids served as solvent for nicotine, which are potential proxidants (ROS sources), whose physiological significance still requires elucidation. The content of these products depend on the type of EC and on the mode of its use, which makes possible to minimize the ROOH generation. The CL methodology has proved to be the most useful tool in assessing the oxidant and antioxidant potentials of nicotine containing aerosols, i.e. tobacco-smoke and emissions from ECs, which exhibit essentially different impact on oxidative developments in a smoker's organism.

532 The possibilities of using fungal fluorophores to assess responses of filamentous fungi to external stimuli

E.V. Fedoseeva, Pirogov Russian National Research Medical University / Pediatric faculty; D. Khundzhua, Lomonosov Moscow State University / Department of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of 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 biotests is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biotests is explained by the variety of reactions to external stimuli, which play 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 fulmantous fungi cultivated under different concentrations of source of bioavailable and non readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalosporium chlorosporioides, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi and humic technological agar 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, 300, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spore suspensions and supernatant liquids) with the 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 chroomophores 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 fluorophores to assess responses of filamentous fungi to external stimuli.

533 Effect of surface functionality on Fe₃O₄ nanoparticles toxicity

I. Kulvalbo, 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. Kyutralieva, Institute of Chemistry and Chemical Technology of Siberian Federal University; M. Freidkin, Lomonosov Moscow State University / Depament of General Physics

Effect of surface functionality on Fe₃O₄ nanoparticles toxicity

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 biotests is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biotests is explained by the variety of reactions to external stimuli, which play 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 fulmantous fungi cultivated under different concentrations of source of bioavailable and non readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalosporium chlorosporioides, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi and humic technological agar 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, 300, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spore suspensions and supernatant liquids) with the 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 chroomophores 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 fluorophores to assess responses of filamentous fungi to external stimuli.

534 Poster spotlight: WE209, WE210, WE211

Obesogens and lipid disruptors

SETAC Europe 28th Annual Meeting Abstract Book
Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
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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 profile of two fish species (Barbatula meridionalis, Squalius laetaunus) 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 (SM) 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 CE1s (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. laetaunus 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 bonds (36:5, 36:6, 38:6, 40:6, 40:7). The results suggest potential lipid oxidation of highly unsaturated PCs, particularly in S. laetaunus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CEs), possibly due to an increase in the energy demand to respond to stress in polluted sites.

539 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.I. Martynuk, University of Florida / Physiological Sciences; V. Ding, Iowa State University
The organochlorine pesticide (OCP) contamination of two like Apopka largely derived from high application use in the muck farms on the North Shore. These practices were discontinued in the 1970’s but fish in Lake Apopka continue to have relatively high body burdens of organochlorine contaminants. Previous transcriptomics experiments have indicated that the OCPs alter endocrine related endpoints in ovary and liver of exposed fish. In addition, changes in lipid transport and metabolic pathways are affected. Current work explores changes in the lipidome of largemouth bass caught in Lake Apopka compared to fish from a relatively clean lake in the Ocala National Forest. We used both a shotgun approach and a targeted approach to quantify perturbations in phospholipids in liver of largemouth bass from Lake Apopka compared to a relatively clean lake. Follow up experiments with fish exposed in the laboratory support the changes seen in the field. Cholesterol was decreased and cholesterol esters were elevated in the livers of fish from Lake Apopka compared to Wild Cat Lake. This finding corroborates reduced hormone biosynthesis in organochlorine contaminated fish. Other changes in the lipidome are consistent with predicted changes that are related to immune dysfunction. Enrichment in Lake Apopka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylethanolamines. The results suggest potential lipid oxidation of highly unsaturated PCs, particularly in S. laetaunus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CEs), possibly due to an increase in the energy demand to respond to stress in polluted sites.

540 Poster spotlight: WE027, WE028, WE029
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
St Schwab, Adolfe Merkle Institute / Materials Science
Engineered nanomaterials are relatively new contaminants with that can enter the environment via an increasing variety and number of waste streams. The long-term toxicity of nanomaterials is not well understood, and these materials are therefore of emerging public concern. In 2011, we published a press release about our scientific publication on the effects of carbon nanotubes on green algae [1]. We found that the nanoparticles 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 hazardous. 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 we got 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., Buechel TD, Lukhele 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/news/nishownnews.php7?getnews=mn-2011-11-09-3109&pc=s02. 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 conlficts 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 / IRES; 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 understood CNTs to be toxic. As a result, Dr. Schwab and her colleagues were accused of fear-mongering. Things escalated to the point that Der Spiegel had to shut down the article’s comments section. Where did things go wrong? How can scientists make sure the media presents their work accurately, but also in a way the general public can understand? We will discuss the diverging roles and realities of science and media, particularly the considerations that scientists and editors need to take into account when they decide to write/publish something.

543 Discussion Nanotechnology

544 Microplastics: The risks of plastics – perceived or real?
M. Kottermann, 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 within food, honey and even drinks 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.

546 Ocean Literacy – changing attitudes and behaviour of society in the face of the problems of the oceans
A. Bertle, Arts-Technalia / Marine and Coastal Environmental Management
The H2020 project ResponSEAble (www.responseable.eu) is trying to raise awareness around the key environmental and socio-economic problems of the oceans through the use of marine and coastal knowledge. By engaging with people at all levels – from children to adults, we hope to bring about a change in their attitudes and behavior, through the promotion of Ocean Literacy. As such, Ocean Literacy is being introduced in the curriculum of K-12 and at university level, up to the Master of Science level. However, changes in behavior and attitudes require changes in the way society perceives and interacts with the oceans. To achieve this, awareness of the problems faced by the oceans and society’s responsibilities to address them must be increased. This talk will discuss the importance of Ocean Literacy in addressing the problems of the oceans and the steps that can be taken to promote it.

547 Discussion Microplastics

548 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. Ajao, 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; M. van den Brink, Alterra Wageningen UR / Atlantic Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University
How can we identify "drivers of mixture risks"? T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; R. Altenburger, UFC Centre 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 mixtures’ effects. In fact, there is evidence that often only a 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 risk” can be formed. Simple concentration addition (CA) or threshold exceedance (TOE) approaches, which is common in all approaches, might not always be justified for the power of the risk assessment. 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 will 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.

A common framework for the assessment of human and ecological risks from pollutant mixtures in European surface waters - case study with > 300 chemicals co-occurring in the Danube A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting; S. Ermler, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences Experimental mixture studies have shown that the toxicity of a mixture is usually greater than the sum of the toxic effects of its components. Qualitative empirical evidence seems to point to the fact that certain mixture effects can occur even though all components in the mixture are present at levels that individually are without observable effects. These observations have lent urgency to the need of evaluating the risks from multiple pollutants both to humans and wildlife. Here, we present a common decision tree and tiered work flow scheme for strengthening 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. Scholze, Starke, 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. Friesche, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology; R. Ottermanns, M. Röß-Nickoll, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; A. Syberzt, RWTH Aachen University / Institute for Environmental Research; C. Ulrich, German Federal Environment Agency UBA / Section Plant Protection Products; S. Knüllmann, Helmnholtz 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 acreage and 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 doses. 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 (PDB, 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, TERsingle dependent, TERsingle dependent ratio, TERsingle dependent ratio divided by TERsingle, TERsingle dependent ratio divided by TERsingle dependent, TERsingle dependent ratio divided by TERsingle dependent deformation). Using TERsingle dependent ratios, 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 regimens 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. Amossé, S. Bart, INRAAgroParisTech; C. PELOSSI, INRA (Institut National de la Recherche Agronomique); M. Enzel, INRA, INRAAgroParisTech

According to the current regulation for the registration of plant protection products on the market, the environmental risk assessment of pesticide use is generally performed under laboratory conditions. Very little information is available in natura, 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⁻¹ of oxycarboxin and 100 g•L⁻¹ of imazalil) and 50 g•L⁻¹ of Copper Sulfate (Cuprafor Micro® and 133 g•L⁻¹ dimethyloxydimethyl), and the mixture of both on two groups of terrestrial oligochaetes (Lumbricidae and Enchytraeidae) after 1, 6 and 12 months (i.e., t1, 16 and t2) of exposure under field conditions. We also assessed the feeding activity of soil organisms using the bait laminar method. Our results showed a lower Shannon index for earthworms in the treatment with the mixture of both pesticides (i.e., 1.51 h•a⁻¹ of Swing Gold® and 4 kg•ha⁻¹ of copper) and in the treatment with the Swing Gold® at ten times the recommended dose (i.e., 1.51 h•a⁻¹) 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 annecic earthworms was only observed at the end of the study at t12. We showed no overall significant difference in the total feeding activity, enchytraeid density and diversity 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 mixture. 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. Our results emphasize the relevance of the nowadays largely non-regulated imidacloprid and thiacloprid in Lufa 2.2 soil. The tests aimed at answering 2 main questions: (i) Is there a difference in the sensitivity to neonicotinoids between the different species? (ii) Are these species suitable for assessing the toxicity of neonicotinoids? Imidacloprid was most toxic, with F. fimetaria presenting around the same sensitivity as F. candida for survival (LC₅₀ 0.56 mg/kg dry Lufa 2.2 soil), and a slight difference in the sensitivity for reproduction, with EC₅₀ for F. fimetaria 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 survival of the first one being least sensitive (LC₅₀ 27 mg/kg dry soil), followed by F. candida (LC₅₀ 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 2.6 mg/kg dry soil) followed by F. candida (EC₅₀ 1.5 mg/kg dry soil), and H. nitidus (EC₅₀ 1.3 mg/kg dry soil). The different species tested presented similar sensitivity towards the neonicotinoids, 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.

558 Dirty dancing: measuring mito movement responses to pesticide residues J. Wittom, Environment Dept, University of York / Environment; T. Alvarez, EcoRisk Solutions Ltd / Dept of Ecological Sciences; M. Reid, HSE Health and Safety Executive / Chemicals Regulation Division; G. Weyman, ADAMA; M. Hodson, University of York / Environment Department; R. Ashauer, University of York / Environment

For a pesticide to be registered for use, the lethal and sublethal effects on 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 – i.e., the individuals do not ingest or contact the substance to which they are exposed to – 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 pyrri, a model species and a neonicotinoid insecticide found in fruit orchards and in horticulture. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mito 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 no movement when exposed to 0.5 μg mL⁻¹ acetamiprid. The mean distance covered fell by 34%; however, when exposed to 0.45 μg mL⁻¹ dimethoate the mean distance covered increased by 11%. No individuals
exhibited avoidance behaviour when exposured to acamiprid 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 in NTAs by quantifying movement behaviour changes in T. pyri. We are also adding to the knowledge relating to movement 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 Hyaoposis aculeifer tests be considered in order to keep them in Tier I 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. Amorim, EPSA - European Foot and Feed 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 *Hyaoposis aculeifer* (OECD 226) is currently being included in the new EU data requirements for the ecological risk assessment (ERA) of PPPs. However, the low sensitivity often shown by this mite towards PPPs, when compared to other invertebrates, makes the test with this species, as it is currently performed, not very useful for Tier I test battery. The current test protocol does not take into account the fact that *H. aculeifer* is a predatory species, and only considers exposure to contaminants via soil ingestion, thereby ignoring food contamination.

Therefore, an adaptation of the test performance, by including exposure via contaminated food, is necessary. The methods described in the standard protocol for mite reproduction test advise feeding the test organisms with fresh preys (e.g. cheese mites *Tyrophagus putrescentiae*) from uncontaminated breeding containers over the test period but, in a real scenario, this exposure is simultaneous for *H. aculeifer* and their preys. Thus, through this protocol, the toxicity of contaminants to *H. aculeifer* might be underestimated. The present study aimed to evaluate the importance of oral exposure to the contaminant as an exposure route to be considered in reproduction tests. Two reproduction tests with *H. aculeifer* were performed (OECD 226) using artificial soil spiked with increasing concentrations of three model PPPs: nicotine (1519, 5126 mg kg⁻¹). Cheese mites were used as food in both tests but, while in one test cheese mites obtained from normal laboratory breeding cultures (clean preys) were added, in the other test, cheese mites previously exposed to Cu (pre-exposed preys) were used. Results showed that *H. aculeifer* fed with pre-exposed preys were more sensitive to Cu than mites fed with clean cheese mites. These data support that the route of exposure represents an additional important route to consider. Therefore, we propose to include oral exposure in the standard reproduction test protocol for mite reproduction test to avoid underestimation of toxicity of contaminants.

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. Höger, 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 in terrestrial organisms as it is available (EFSA 2017). One possible 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, DT₅₀) 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 BPT (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 in terrestrial organisms. The objective of this project is to provide a suitable data base which will help to clarify how to address terrestrial bioaccumulation in the B assessment and to define trigger values for the bioaccumulation factor (BAF) obtained from bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the B/vB criteria in the scope of the PBT guidance revision. For this aim, the study comprised the following soil via preys: 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, o-tolylphenyl 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 Koc or similar substance properties and the BAF were observed. Additionally, no correlation was found for the substance-specific BAF from fish studies and BAF determined with earthworms. Therefore, lipid- and Cₐ normalized 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 BAF trigger value of 1.00 is proposed as a general trigger to incorporate bioaccumulation in terrestrial organisms. Other criteria like non-degraded 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, CRIBD / 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. Lanfranconi, EcoAct; L. Petti, University of Chieti-Pescara / Department of Economic Studies

S-LCA is a multi-criteria, multi-stakeholder and multi-step methodology 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 monitoring, 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 S-LCA; (2) to highlight the methodology to identify social hotspots along the whole life cycle, and in particular in the relevant phases of the life cycle, such as raw material production and end-of-life; (3) to show how these 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 main 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 of the value creation along the value chain. On the basis of the main challenges for S-LCA identified in this study, recommendations were idented, 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
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Growing interest in especially leather industries facing constant discussions on social compliance mostly in relation to bad working environments and thus cause 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 life cycle assessment (LCA) and toxicological critical life cycle impact indicators (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
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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, it is also 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 more than ten years the company has 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 framework such as the sustainable development goals will be discussed.

566 Social footprint of a packaging waste deposit-refund system in Spain
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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 unused packaging. The social footprint developed by Weidema et al. (2014) is an example of how to apply sum total of social value 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 + PG. 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 DR 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 associated transport). This study provides the main lessons from 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
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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 and 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 for predicting the release of chemicals to static experimental reliable toxicity metrics for QIVIVE (e.g., membrane concentrations). Of the 306 chemicals included in the ACEA_T47D_80hr_negative assay simulations, approximately 2/3rds had predicted membrane concentrations in the range expected to result in baseline toxicity (membrane dysfunction/necrosis). Chemicals with predicted membrane concentrations well below the baseline toxicity range may act via a specific mode of action and could therefore be prioritized for further investigation.

569 Experimental exposure assessment in in vitro bioassays for organic acids

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Improved assessment of exposure in in vitro toxicity assays is essential for the application of in vitro data for chemical risk assessment. Equilibrium mass balance models have been developed to convert the reported nominal effect concentrations of the chemicals in in vitro assays to corresponding concentrations in the test system. This allows reliable models are available to calculate the binding of neutral chemicals to lipid, protein, medium and cells, the binding of organic acids to biological materials cannot be easily predicted. Here we applied a 3 phase partitioning method to measure 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., C<sub>E</sub>). 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, tolaswarde, warfarin, tricosan, and genistein. A large subset of the chemicals included in the ACEA_T47D_80hr_negative assay simulations, approximately 2/3rds had predicted membrane concentrations in the range expected to result in baseline toxicity (membrane dysfunction/necrosis). Chemicals with predicted membrane concentrations well below the baseline toxicity range may act via a specific mode of action and could therefore be prioritized for further investigation.

570 A versatile and low-cost open source pipetting robot for automation of toxicological and ecotoxicological bioassays

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Permeation 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 (Oncorhynchus mykiss) intestinal cell line RTgut, 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 (logHLC = -5.8 to -2.2) and hydrophobicity (logK<sub>OW</sub> = 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 the model, which correlated with the logK<sub>OW</sub>. The chamber enabled stable exposure concentrations and close to full recovery at the basolateral compartment, especially at times of marked exposure modification. This ability of the RTgut barrier model to help develop strategies to link in vitro permeation with the prediction of bioaccumulation factors for fish. Moreover, the well-defined exposure scenario in our system comprises a prerequisite for studying mechanisms underlying chemical permeation, such as active transport or biotransformation.

572 A new paradigm in water sampling - how can we challenge the needs of effect-based monitoring?

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In vivo and in vitro bioassays (effect-based methods, EBM) are increasingly used for the water quality monitoring to complement chemical analysis. In a holistic point of view, sampling is the starting point and an integrated part of the whole analysis workflow. However, sampling for effect analysis is more challenging than for chemical analysis. Thus, the aim of this paper is to discuss (1) the requirements and challenges of sampling for EBM and (2) to present the recently developed large-volume solid phase extraction apparatus and apparatus (LVSEP) as a
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 makes 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 full automation of the packaging 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 Rhein 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
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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 AC₅₀ 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 AC₅₀ 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 95th percentile of the range of AC₅₀ 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 prioritized earlier 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).

574 Toward the Comprehensive Profiling of Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl Substances in Firefighting Foam Impacted Soils
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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 perfluorooctyl and polyfluorooctyl substances (PFAs). Following the prioritization of firefighting training activities or fire emergency response, the soil is typically the first environmental compartment impacted. In such samples, newly identified PFAs 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 perfluoroalkyl 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 some dilutional effect to the lack of matching internal standards. If consistent and method recovery studies 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., AFF), which are critical to the risk assessment of emerging compounds. Aiming at overcoming the limitations in the quantification of target PFASs in weathered soils and soil matrixes amended with AFFF-impacted soils, was therefore evaluated. Multiple extraction methods were assayed to recover PFASs in AFFF-impacted soils and 28 industrial textiles have been investigated 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 aniline-based (e.g., PFHxSsAm) PFASs at such sites.

575 Investigation of perfluorooalkyl and polychloroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination
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Perfluoroalkyl and polychloroalkyl 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 repelling 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 deal 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, sulfohalomides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluorooalkyl 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: Evident in Longitudinal Birth Cohorts from the Faroe Islands
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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 there are important gaps for mitigation. A time series of serum samples of 19 PFASs (SPFAs) 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 SPFAS 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. Perfluorooarboxyllic acids (PFCAcs) with nine or more carbons (C₉₋₈) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, r = 0.72). Toxicokinetic modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfate: 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 SPFAS exposure after 2000 were achieved by the rapid phase out of PFOS and its precursors in consumer products.
This has led to a point source input of pollution of soils, waters and biota in close proximity to these areas. The use of PFAS containing substances by the textile and paper making industries, as well as their presence in waste sent to landfills represent several diffuse source pollution pathways. The case studies presented encompass all of these inputs, and methods used to monitor the behavior of PFAS in soil, ground water, surface water and biota (including the use of passive samplers) will be discussed. Understanding the partitioning and leaching behavior of PFAS is crucial to develop methods to remediate the pollution. This is because PFAS has been widely used in a variety of commercial and industrial processes and in consumer products, and the production and use of PFAS is expected to continue. The regulation of PFAS is currently under the spotlight and this is of great importance. Perfluorohexane sulfonate were recently included on the list of Substances of Very High Concern in REACH. PFOS is included in the water framework directive and an environmental quality standard is often used in order to set clean up targets. The remediation of PFAS impacted sites presents unique challenges and current remediation of water often relies on pump and treat using activated carbon filters to sorb PFAS. There are fewer suitable remediation methods for soils. Through the case studies presented, different remediation methods that are currently being used in the field and lab (pump and treat and sorbent amendment) will be presented. Sorbent amendment has been shown to be a promising approach with reductions of PFAS leaving up to 99%.

Improvements in environmental exposure assessment: development and application of tools across industry sectors, regulatory agencies, and international boundaries (I)

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Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment

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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 limitations of the tools 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 high diversity of ecosystem structures and functions in risk assessment. Finally to transfer new scientific developments into the realm of regulatory risk assessment, we propose the formation of expert groups that compare, discuss and recommend model modifications and updates and help develop practical tools for risk assessment.

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Development and update of environmental exposure assessment tool EUSES for REACH and BPR Regulations

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Introduction Both REACH Regulation and the Biocidal Products Regulation requires that the chemicals addressed by the respective legislations are used safely. Both regulations require environmental exposure and risk assessment of chemicals. EUSES (the European Union System for the Evaluation of Substances) is a tool developed by authorities in the 90’s to support environmental exposure and risk assessment chemicals in line with the methods described in the technical guidance document (TGD 040) that has treated the assessments practices for these three policy areas at that time. EUSES last relevant update was in 2004, so that the tool is now partly outdated. An update is needed since the availability of an up-to-date tool is critical for both REACH and the BPR to function efficiently, both for applicants/registrants, MScAs and ECHA. EUSES has several modules (release estimation, fate and distribution, partitioning, exposure and risk assessment) that is highly needed 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 high diversity of ecosystem structures and functions in risk assessment. Finally to transfer new scientific developments into the realm of regulatory risk assessment, we propose the formation of expert groups that compare, discuss and recommend model modifications and updates and help develop practical tools for risk assessment.

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PFAS pollution at airport sites: point and diffuse sources, fate and transport and remediation

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Using Norwegian airports and fjords as case studies this work will present the identification of point and diffuse source PFAS inputs, the environmental behavior (partitioning) of these compounds in relation to their presence in soil, ground water, surface water and biota as well as suitable remediation methods for different sites. The once highly desirable physicochemical properties of PFAS (resistance to heat, water and oil) has led to a large-scale environmental problem as these properties go hand in hand with a low degradative potential, high persistence, high mobility and toxicity. At airport firefighting training facilities aqueous firefighting foams (AFF) containing PFAS have been used in order to practice extinguishing fires. The once highly desirable physicochemical properties of PFAS (resistance to heat, water and oil) has led to a large-scale environmental problem as these properties go hand in hand with a low degradative potential, high persistence, high mobility and toxicity. At airport firefighting training facilities aqueous firefighting foams (AFF) containing PFAS have been used in order to practice extinguishing fires.

Membrane-water partition coefficients to aid PFAS risk assessment

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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 (Kow) can not be determined experimentally. Due to the lack of experimental data, QSARs to predict Kow are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant (pKb) 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”. One of the main applications of a Kow 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 of 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 a strong interaction between the analyte and the receptor, and simply takes 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning (Kow) of the ionic perfluor species, and the predictions on pKb. Whereas COSMOtherm accurately predicts Kow for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pKb of alternative PFASs, e.g. GenX, which are negative and may exert a great pull on electrons of any ionizable group, thereby e.g. rendering perfluorooctanoic sulphonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

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Impacts of ocean circulation on the marine PFOS burden in an era of geographically shifting emissions

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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 residues, and a requirement to take account of transport processes that transport small amounts of PFOS, just like data from global molecular biomonitors, provide a picture of human and ecological health. The dramatic reduction in PFOS releases around the year 2000 after phase-out of the parent compound to PFOS and its precursors is well documented in Europe and North America. By contrast, some studies have suggested a potential increase in releases from Asian sources, which may drive continued exposure in marine food webs. In order to meet 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 high diversity of ecosystem structures and functions in risk assessment. Finally to transfer new scientific developments into the realm of regulatory risk assessment, we propose the formation of expert groups that compare, discuss and recommend model modifications and updates and help develop practical tools for 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 possible options and the establishment of a roadmap for the process to carry forward (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.

582 Advances in exposure assessment of fertilizers: development of a fertilizers environmental exposure tool and generic exposure scenarios under REACH

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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 Fertilizer Europe and the FARM REACH consortium, the fertilizers 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, ECTOC-TRA, CHESAR), no local scenarios for direct soil application were considered to test the framework proposed for exposure assessment. The scheme serves as a useful base to guide additional exposure 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 nanono-particles. There is currently no standard protocols to measure the durability of the Al–nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. Kah M, Hofmann T. 2014. Environ. Int. 63:224–235. 2. Kookana 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.

585 Can we model emissions, fate and exposure on a global scale? A case study of PCB 153 in human milk

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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 have failed up to this challenge on a global scale. Can we now predict persistent, hydrophobic and semi-volatile polluted as well as chemical. We used physico-chemical properties recommended by Schenker et al.1 and global historical estimates developed by Breivik and co-workers2 to drive the global multimedia fate and transport model BETR Global.3 The fugacities of PCB 153 in air, water and soil, modeled at a spatial resolution of 3.75° x 3.75°, were re-gridded 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.4 The human diet in ACC-HUMAN was parameterized for each country based on the WHO Global Environmental Modeling System (GEMS) valori diets.5 The modeled concentrations of PCB 153 in human milk were compared with the concentrations measured in the WHO/UNEP global monitoring program for POPs.6 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 model of chains include an under-prediction of the rate of decrease in PCB concentrations in air since the 1980s and inadequate treatment of food sourcing.7 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., 2011, 50, 798-805. M. MacLeod et al., Environ. Pollut., 2011, 159, 1442-1445. G. Czub and M.S. McLachlan, Environ. Toxicol. Chem., 2004, 23, 2356–2366. https://undatacatalog.org/dataset/gemsfood-consumption-database M. van den
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 aquatic 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 all 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 lifecycle 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.

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (I)

592 Occurrence of cyanotoxins in Greek lakes A. G. Bojadzija, UMR CNRS Ecobio; M. Borman, UMR CNRS Ecobio / UMR Ecobic; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phytotoxines / Unité DYNECO / Dept. ODE; C. Wieczu, Université de Rennes 1 / UMR CNRS ECObio

Thanks to their adaptation capacity, cyanobacteria have become a major threat to the aquatic environment. 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 transferable to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet been fully 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 cultures with D. magna 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 10^5 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 mcy-c are currently in progress. Vice versa, microcystin PCC7806 MC-LR, MC-LA, MC-YR, MC-YH, MC-RR and MC-LR were detected in M. aeruginosa 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.

593 Interactions between cyanobacteria and daphnia G. Bojadzija, UMR CNRS Ecobio; M. Borman, UMR CNRS Ecobio / UMR Ecobic; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phytotoxines / Unité DYNECO / Dept. ODE; C. Wieczu, Université de Rennes 1 / UMR CNRS ECObio

Teratogenic retinoid-like compounds produced by cyanobacteria into surface waters K. Hilšcherová, 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 - UFZ / Effect-Directed Analysis; A. Jonas, Masaryk University, RECETOX / Faculty of Science; J. Přibybová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment - UFZ / Effect-Directed Analysis; P. Zeman, Masaryk University, RECETOX / Research centre for toxic compounds in the environment - UFZ / Effect-Directed Analysis; D. Herout, Masaryk University, Faculty of Science, RECETOX; F. Šváb, Masaryk University, Faculty of Science, RECETOX; L. Sehnal, 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, RECETOX / Research centre for toxic compounds in the environment; D. Kalašová, Masaryk University, RECETOX / Research centre for toxic compounds in the environment; M. Mertusz, Masaryk University, 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
developmental effects in zebrafish (Danio rerio) and frog (Xenopus laevis) embryos. Both the phenotypes and effective concentrations of exudates corresponded to all-trans retinoic acid (ATRA) equivalents, supporting the hypothesis that the teratogenic effects of cyanobacterial exudates are likely to be associated with retinoid-like activity. Non-target analyses and comparison of the spectra of compounds present in exudates with different retinoid-like activities pointed to structural features of compounds contributing to the retinoid-like activity. In the approach of a “virtual EDA” we have characterized in detail retinoid-like activity of 53 samples of exudates from 4 algae species and 15 cyanobacteria species/strains. Only several species of cyanobacteria showed detectable activity, while there was no activity in any algal exudates. We have identified a set of compounds that contribute to the total retinoid-like activity in both laboratory and field samples, including ATRA, 9/13cis retinoic acid, but also several novel cyanobacterial metabolites, such as 5,6epoxy-RA or 4keto-ATRA with high retinoid-like potency. In general, retinoid-like activity has been shown to be associated with cyanobacterial water blooms dominated by many different species, which documents that production of retinoids by cyanobacteria in the environment is a common phenomenon. This study was supported by the Czech Science Foundation project No.18-15190S and FP7 SOLUTIONS project No. 603437.

595 (Co-)Production Dynamics of Cyanobacterial Peptides

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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 a vast array of bioactive peptides. Information on the research 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 weight. Simultaneously, the 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.

596 Development of methods for Measuring Total Microcystins in Fish Tissue using the 2-methods-3-methyl-4-phenylbutyric acid (MMPB) procedure.


There are limited methods for the analyses of multiple alkali 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 by Cyanobacteria, Prymnesium parvum (Prymnesiophyceae), and Euglena sanguinea, including microcysts, saxitoxins, cylindrospermopsin, anatoxin-a, prymnesin and euglenophycin. The objective of the first phase of this research was to spike experimental fish and cell cultures with 3 weight 39 97 3g 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 coinker measurements. Extraction methods and analytical methods being developed for this research will also be utilized for development procedures for plankton, periphyton, and macroinvertebrates. Ten and 100 mg of fish homogenates from fish containing 1, 4 and 14% lipids were spiked with 4 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 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 that 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: hydrolysis and toxicity

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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 leach 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 hydrolysis 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) showed to be a highly pH dependent base-catalyzed reaction. The half-life was around 330 ±220 days at pH 5.1 and 26°, while decreased to 0.06 ±0.01 at pH 10.0. The hydrolysis was also influenced by temperature with an activation energy of 35.9 ±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 quinoaseedcoat were 2.91 ±1.00, 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

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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, 20% industry, and 5% non-profit. AOP networks, quantitative AOPs, collaboration and communication on AOPs, 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 future AOP research and regulatory initiatives. These themes were used as workgroup topics for a PestellTM 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 toxicology 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 application case studies were 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

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An invited group of scientists participated in a SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway (AOP) 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 a more efficient and effective 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 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.

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. Conolly, US EPA RTP; B. Landsemann, JRC; European Commission; 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. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory Qualitative precipitation and asbestos are generally known. 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.

601 Use of Adverse Outcome Pathways to Inform Decisions on Chemical Innovation, Regulation & Stewardship

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Adverse Outcome Pathways (AOP) 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 (and recognition of gaps in knowledge) generally over 10 years. 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 review expert ranked exercise, and answers to FAQs, was used to refine and enrich derived 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 traditional ecotoxicology. 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.
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 Environment” 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) Pellston™ 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 Pellston 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 risk assessors and managers. Furthermore, when 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. Biggert, 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, herring, 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 of Natural History. 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 1970’s, 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 BFRs). 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 monitoring data and the accumulation of selected FRs going back to the 1980s, e.g. from coastal herring eggs, freshwater fish, tree leaves and roe 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 Environmental Specimen Bank (MESB) 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 subsequent expression studies and 2) are feasible, have been undertaken. These are taking 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 proteomic profiling of tissues used to evaluate a new high-coverage well-scarfed genome, and 2) the discovery of using total genomic DNA as an alternate method to obtain 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. Hulse, P. Roskotwski, NILU Norwegian Institute for Air Research.

The environmental specimen banks (ESBs) handles 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 ensure that the samples are stored in an environmentally safe 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 emit or release CECs to the indoor environment. To evaluate these 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 proteomic profiling of tissues used to evaluate a new high-coverage well-scarfed genome, and 2) the discovery of using total genomic DNA as an alternate method to obtain 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
Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (II)

610 Poster spotlight: TH273, TH288, TH285

611 Environmental risk assessment of multiple stressors - chemicals and ionizing radiation
K. Petersen, NIVA - Norwegian Institute for Water Research; J. Brown, Norwegian Radiation Protection Authority; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment
Increased focus on cumulative effects of pollutants in the environment has led to the development of several methods for environmental risk assessment (ERA) of chemical mixtures and for ionizing radiation. Even though no generic impact and risk assessment model exists to accommodate different types of stressors (e.g., multiple stressors such as radiation, metals, and organic compounds), larger harmonization and integration of approaches taken can be achieved to improve and combine the existing models for ERA of chemical mixtures and for ionizing radiation from radionuclides. Here, we present a potential 2-tiered approach for risk assessment of multiple stressors by assuming additivity of chemicals and ionizing radiation as a first approach in order to combine a framework for ERA of chemical mixtures with the ERA of radionuclides. The proposed approach was applied to a real case scenario: emission from decommissioning of old oil 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)

612 Assessing health risk associated with micro-pollutant mixtures in drinking water: an innovative combination of in vivo and in vitro assays and analytical screenings
Y. Levi, Univ. Paris Sud / ESE UMR 8079; J. Loret, o. schlosser, CIRSEE Suez Environment; a. guillon, Suez / CIRSEE; m. favier, INSERM Institut Cochin; v. domenge dupeyrat, Université Paris Sud; M. Binbot, V. Huteau, Univ. Paris-Sud / UMR ESE; m. plewa, b. marinas, University of Illinois at Urbana Champaign Assessing health risks associated with organic micropollutants in drinking water is a major challenge for public health and improvement of the drinking water production units. Given the low concentrations, the diversity of emerging contaminants and chronic exposure, it is essential to combine chemical analysis with biotests. In vitro bioassays or in vivo tests on aquatic animals allow effect screenings but interpretation for health risk assessment is difficult. We have designed an innovative research program (to our knowledge, the first of its kind applied to drinking water) that aimed to simulate human life-long exposure to micro-pollutants in drinking water for in vivo tests on mammals... Over 4 seasons, we have concentrated by 100 the organic fraction from large volumes of 4 types of water: river water, drinking water produced by a treatment plant with this raw water, reverse osmosis treated water and bottom mineral water. 2 generations of mice (10 males, 10 females for each type of water) were fed with contaminated water for 1 year. Based on the used exposure scenario, in order to reproduce in the animals, the exposure as a man drinking the water for 70 years. We carried out complete chemical analysis (quantitative targeted analysis, innovative non-targeted screening by HPLC and GC-2D with mass spectrometry), offering a new vision of the contaminants distribution. In vitro bioassays were used to evaluate endocrine disrupting effects (ER and AR receptor), cell toxicity tests (mammalian and Microtox) and genotoxicity on CHO cell assay. Mice growth, survival rate and behavior in open field and in elevated plus maze were studied. Histological analysis on 19 organs and blood hormonal assays were performed. This complete and innovative protocol did not show significant difference of survival rate and growth between the four mice groups. In contrast, histological and hormonal effects were observed in the mice exposed to the raw river water concentrates as opposed to the mice exposed to the waters of better quality. Several tests suggested a greater sensitivity of the 2nd generation mice as compared with the 1st-generation. Biotests confirmed the overall good quality of the treated water, whatever the treatment process, despite the presence of organic micropollutants. The presentation will show the detailed protocol for the major approach, Phaeosytis antarctica and C. pyrenoidous algae... An integrated health risk assessment with regard to long-term exposure to real mixtures of organic pollutants in drinking water.
(ERCMs) 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 Zeebrugge (Belgium) to spike several 72 h growth inhibition tests with the marine diatom Phaeodactylum tricornutum following ISO 10253. The different growth inhibition tests were performed over a period of 16 months with tests 0, 8 and 16 months after extraction. We 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 taken: first, we identified 4000 different microbial care products, pesticides, pharmaceuticals, (alkyl)phenoins, phthalates and steroids. The analysis revealed that testing occurred at contaminant concentrations similar to those measured in water grab samples taken during sampler deployment. Remarkably the observed stimulation effects remained above 5 % when diluting the extracts up to 125 times. These findings suggest that P. tricornutum would remain affected by ERCMs even if their environmental concentrations would be reduced considerably. The disappearance of the observed stimulation effects after an extract storage time of 16 months led to the hypothesis that the main contributing contaminants causing stimulation must have degraded over time. In future work it would be of high interest to apply multivariate analysis (i.e. principal component analysis) to identify main contributing contaminants to the observed effects.

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; A. Lahm, Bioinformatic consultant.

617 Risk assessment of soil organisms in field: dealing with earthworm community Y. Bayona, P. Brulle, ANSES, CNIHVE; A. Bovet, ANSES, CNIHVE; F. Estévez Protection Products (PPP) Joint Research Project 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 Dunnet test and Williams test. The main weakness pointed out for the PRC 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, SETAC Europe 28th Annual Meeting Abstract Book

661 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 Ekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natál da Luz, University of Coimbra; R. Carvalho, European Commission Joint Research Centre; 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

662 Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (II)

663 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 Ekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natál da Luz, University of Coimbra; R. Carvalho, European Commission Joint Research Centre; 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

664 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 approach of soil 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 organism groups. These uncertainties in the accuracy of lab to field extrapolation might lead to an underestimation of the toxicity of test chemicals for 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 set on the identification of key parameters influencing toxicity in different groups of species in higher tier regulatory conceptual models allowing the extrapolation from the lab towards the field situation.
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 recently 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 loss of these cannot be quoted as a decisive factor, but the all explaining reason for this inacceptable loss of biodiversity cannot be assigned easily to a single factor and is more due to a multifactorial complex of influences which 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 transparent quantification 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 transferred for the whole 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. Roemhke, ECT Ökotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

In February 2017, 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 additional research is to identify the need and the priority for providing for 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

Wood-fibres composite in substitution of a synthetic material to enhance sustainability purposes for automotive sector S. Maltese, Magneti Marelli Spa / Powertrain Division; a. bonoli, DICAM- Alma Mater Studiorum - University of Bologna / DICAM; L. Zanchi, M. Delogu, University of Florence / Department of Industrial Engineering

Nowaday 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 expendidture, light-weight profile and more energy credit through their incineration [2-4]. This study presents the application of a new industrially 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. References [1] Paratore A., Curci 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., Drza! 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. World Futures: The Journal of New Directions 71. 2015. [4] Scholz A. Toschki, M. Ross-Nickoll. 2017. Environmental Research / Institute for Environmental Research - SETAC Europe 28th Annual Meeting Abstract Book

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. Mistrutta, 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 available on the market, such as LiMnO₂, Li(NiₓCoᵧMn₁₋ₓ₋ᵧ)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 supply of raw materials. In this scenario, the authors carried out a Life Cycle Assessment of an 11.4 kWh LMO-NMC battery cells usable in Plug-in EVs, with the following aims: to assess the impact of the mineral, fossil and renewable resources depletion (MFRRD); to estimate the requirement of CRMs; to identify the contribution of each cell component to the MFRRD; to compare the LMO-NMC LIB cell technology with an NMC cell technology available in the literature, with reference to the MFRRD and CRMs requirement. The LMO-NMC battery cell technology is modelled as 0.5Li₃MnO₂ – (0.5NiₓCoᵧMn₁₋ₓ₋ᵧ)O₂, using both primary and secondary data. The cells of the 11.4 kWh LMO-NMC battery are selected as functional unit. The system boundaries include RMs supply, manufacturing, transports and infrastructures. The results show that the LMO-NMC cells have an impact on MFRRD of 0.34 kg Sb_eq. The relevant share of MFRRD (34%) is caused by the cobalt sulphate production used in the cathode. Of the 27 CRMs for the EU, the analysis shows the relevance of only two of them: cobalt and barite. From the comparison with the NMC cell, carried out with reference to 1 kWh of nominal capacity, results that the MFRRD impact and the cobalt requirement of the LMO-NMC technology is lower, respectively, of a percentage equal to -4.4% and -29% than those of the NMC. The results indicate that the LMO-NMC cell could be a sustainable technology to meet the demand of the EV market as it involves a lower impact on MFRRD and a lower consume of CRMs compared to the NMC cell.

624 Analysing the environmental impacts of alternative solutions for passenger transportation: LCA of a charging station for e-bicycles G. Sdralliello, University of Roma Tre / Department of Business Studies; R. Salomone, L. Giuttari, G. Saia, G. Ioppolo, University of Messina / Department of Economics; M.C. Lucchetti, University of Roma Tre / Department of Business Studies

The transport sector causes a high environmental impact which are mainly concentrated in 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

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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 utilisation 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 e-bicycles, aimed at 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 result of this study is that the Climate Change impact related to the whole life cycle of the investigated charging station is 13,816.5 kg CO₂eq per FU. 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. Cutiaia, C. Chiaradonna, F. Porta, ENEA; M. La Monica, C. Scagliarino, 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 the penetration and the electrification of the urban vehicle fleet 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. Alberts, P. Collet, D. Lorne, IFPEN / Economics & Technology Intelligence; A. Benoist, CIRAD / UPR BioWooEB ELSA research group; A. Hélias, Montpellier SupAgro / LBE 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 equilibrium economic part thus detecting bioanalytical responses caused by mixtures of all bioavailable compounds from the aquatic environment is practically and economically not a viable option, there is a growing interest in effect driven monitoring. Additionally, concentrat ecological risks due to micropollutants, similar classifications were obtained with the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect driven 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 costs. 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 micropolitot concentration by passive sampling with testing of 15 bioanalytical 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 bioanalytical 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 hot-spots of chemical pollution. It is applied particularly at agricultural sites. In addition, increased ecological risks were also observed at rivers receiving WWTP 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 msPAF determination (potentially affected fraction of water organisms due to multiple mixture exposure). At most 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 Speedick passive sampler extracts M. de Baat, University of Amsterdam / IBD-FAIME; M. Thao Nguyen, Waterproof; R. van der Oost, Wateren / Onderzoek en Advies; G. Sileno, Wateren / Research and Development; M. Thao Nguyen, Waterproof, L. Mora, 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 costs. 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 micropolit concentration by passive sampling with testing of 15 bioanalytical 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 bioanalytical 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 hot-spots of chemical pollution. It is applied particularly at agricultural sites. In addition, increased ecological risks were also observed at rivers receiving WWTP 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 msPAF determination (potentially affected fraction of water organisms due to multiple mixture exposure). At most 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.

Developments in the use of bioassays for chemical and environmental risk assessment (II)
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, UPLC–QToF mass spectrometric 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) into freshwater is a major source of exposure for aquatic organisms. Receptors in the environment can be triggered by this exposure, which can lead to specific toxicity effects. The gene expression and hormonal activities of selected compounds in WWTP samples were investigated. The detected hormone-like activities in WWTP samples and pursued to identify compounds responsible for them. To this aim, CALUX bioassays and a UPLC–Q-ToF 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 288,479 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 reconstructed 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 mostly reduced. The detected androgenic and estrogenic activities were present in similar concentrations in untreated as in treated WW. The glucocorticoid activity in influent was fully explained by prednisolone, triamcinolone acetonide, dexamethasone and amicinonide. In effluent however, detected hormones could only explain 15% of the activity, indicating the presence of unknown (metabolites of?) glucocorticoids in effluent. The androgenic activity in influent and effluent and estrogenic activity in effluent could respectively be attributed to the presence of 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-EDA 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
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Wastewaters represent a major pathway of introduction of EDCs into the aquatic environment. Considering the presence of EDCs in wastewater, the identification of their possible transformation products, many EDCs are currently unknown. Therefore, characterization of the presence and identification of EDCs in wastewaters are major issues in order to assess their occurrence in natural waters and the associated risks for wildlife. To date, in vitro assays based on luciferase reporter gene expression, are available to assess the biological activities of samples in a quantitative, sensitive, specific and fast way. The comparison of concentrations derived from bioassays and from chemical analyses allows assessing the contribution of micropollutants to the overall biological or toxic activity of a sample. In this study, a systematic approach combining effect-directed analysis (EDA) and high resolution spectrometry was applied to several urban WWTPs to establish an overall contamination diagnostic and to identify major contaminant that could be released in environment. For this purpose, crude extract from influent and effluent of an urban WWTP were analyzed by LC-QTOF and tested on estrogens, androgens and glucocorticoid receptors. The non-target screening allowed detecting more than 7000 and 4000 signals in influent and effluent extracts of WWTP, respectively. We observed that 70% of compounds detected in effluent were introduced by the wastewater treatment process suggesting the formation of transformation products. Concerning the strategy implemented to identify compounds of interest, it was decided to use effect-directed analyses methodology to have a tool to target active compounds in relation with selected biological activity. To this end, the crude extracts were fractionated by HPLC and biologically active fractions were isolated for further chemical identification. Biological fractionation profile of samples indicated the presence of estrogenic and glucocorticoid activities at all studied sites with very similar fractionation patterns between sites, highlighting major and recurrent individual fractions. The identification of active compounds was performed using LC-QTOF and several drugs and their transformation
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. Shekara, Saskatchewan; E. Chau, 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 that impact the status of Nechako Watershed. In 2006 the Nechako white sturgeon was identified as a Nationaly 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 (CGW). 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 CGW is composed of First Nations members, local and regional government representatives, and public volunteers. The CGW plays a crucial role in communication, public outreach, and promoting community involvement. Activities of TWG and CGW support the mandate of the NWSRI through direct involvement of First Nations 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. Mi, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amaraswansha, 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 is utilizing 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. Gravel, M. Séguin, Centre d’études nordiques, Université de Montréal / Department of Biological Sciences; J. Gérin-Lajoie, Université du Québec à Trois-Rivières / Centre d’études 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. Mickpegak, Sakkulq Landholding Corporation Kuujuaraapik; M. Amyot, Université de Montréal / 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 socio-economic issues important on both bio for life. On and in the for Indigenous communities 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-Wapmagoutsootii (K-W) and Kangiqsualujuaq in Nunavik (Northern Quebec). 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 will present results from a community-driven research project in Nunavik: Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and bioamplify in northern fish? 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 species. In collaboration with the community, community 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 Papatānūkū: A Collective Response to Healing T. Godfrey, H. Hirere, Te Whare Whanga O Awanuiarangi / School of Undergraduate Studies The use of pentachlorophenol (PCP) as an anti-sapstain 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 Ngati Awa people. The pervasive effects of contaminants upon both human and environmental health has led to the formulation of a collaborative group: Te Ohu Mo Papatūānuku. The collaboration is steered by indigenous members of Ngati Awa, whilst being strongly supported by scientists, local government agencies, and industry. As a consequence of ongoing research, the use of a rather unique approach utilising combined myco- and phytoremediation to remediate dioxin-contaminated land has been adopted. Whilst implementation of the approach is underpinned by science, the use of “nature to heal nature” is an approach that resonates with the indigenous communities. Contemporary environmental problems resulting from anthropogenic activities often require the use of scientific based solutions. Hence, even when indigenous participation is encouraged by the scientific community as part of the problem solving process, the contribution of indigenous knowledge may be considered of less value than scientific knowledge. Of vital importance to ongoing environmental protection, however, is the role of indigenous knowledges – indigenous relationships informed by binding and enduring familial links with lands, waters, and people. This presentation builds upon previous presentations detailing the journey of the Te Ohu Mo Papatanauku research collaboration – using a synchronistic approach –
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 Orebro / 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 is 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=111) 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 PFAs modelled. This ratio varies across individuals and is approximately two to three times higher than previously estimated. Ongoing work will investigate whether this trend holds for other PFASs 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 among 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 freshwater ecosystems in regulatory frameworks H. Stuedel, Fraunhofer IME Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; C. Diaz Muñiz, Cantabrian Basin Authority; H. Garellick, 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 Chemistry and Production; D. Shemin, National Institute of Natural Sciences, Faulty of Science and Technology; Y. Shevah, Consulting Engineers and Planners Ltd; 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 influence 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., 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 2013/39/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” (#2011-060-1-600).
**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. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Biological Sciences, The University of Alabama; S. M. Cahoon, 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 usage. In addition, an overarching systematic approach to studying and quantifying 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 review, and 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 a greater deal of interest. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aim of the present study was to verify the suitability of biochemical responses of estuarine fish (Microspogonius furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as biomarkers to evaluate the environmental quality assessment in tropical estuarine of Maranhão State, Northeast Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban-phaseout and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age group trends are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure biomarkers from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

643 Biomarkers for the assessment of water quality in tropical estuarine environments in northeast Brazil

M. Jorge, Universidade Federal Maranhão / UFMF / Oceanografia e Limnologia; A. Bianchini, Universidade Federal do Rio Grande - FURG / Instituto de Ciências Biológicas

In attempt to define and measure the effects of pollutants in the aquatic ecosystem, biomarkers have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aim of the present study was to verify the suitability of biochemical responses of estuarine fish (Microspogonius furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as biomarkers to evaluate the environmental quality assessment in tropical estuarine of Maranhão State, Northeast Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban-phaseout and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age group trends are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure biomarkers from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

644 Monitoring of priority substances in German freshwater fish of different age, size and trophic level


Beside monitoring of chemicals the implementation of the Water Framework Directive (WFD) also requires the identification of certain priority substances (PS) in fish tissue. With the WFD daughter directive 2013/39/EU additional compounds were categorized as PS and for several of these environmental quality standards (EQSs) for biota have been introduced. This project was initiated to support the implementation of the WFD biota monitoring by comparative investigations and to propose an appropriate fish monitoring strategy which integrates all WFD 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 Starnberg and a lagoon at the Baltic Sea. For each site three of the 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 examination of otoliths. For each fish species and each age group, fat contents were determined only in the fish fillet and carcass pools. Data are evaluated to derive recommendations for an optimal WFD biota monitoring and reporting. An important aspect is how biota burdens of PS are influenced by sample collection. Which fish species 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.

645 Using Paleotoxicoecology to Assess the Toxicity of Lake Sediments Impacted by Legacy Gold Mining in Yellowknife, NT, Canada

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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 fish species 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
646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms
S. Campillo, Instituto Español de Oceanografía / Centro Oceanográfico de Vigo; B. Fernández, IEO; M. Albentosa, Instituto de Pesca y Recursos Marinos / IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; J. Cachot, University of Bordeaux / EPOC; S. Keiter, Orebro University / MTM Research Centre; J. Lee, Sungkyunkwan University

648 Microplastic size-dependent toxicity, oxidative stress induction, and multixenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus koreanaus)
C. Jeong, J. Lee, Sungkyunkwan University

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. leached chemicals, are largely unknown. 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 terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polyactic acid (PLA) were cut and extracted in a sonication-assisted, solvent-based procedure mimicking worst-case leaching. 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 ARE32 assay. Two-thirds of the products leached chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response.

Six 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 unspecific toxicity, oxidative stress and antiandrogenic 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 androgenic activity. So far, at least 1/3 of the tested products triggered a lethal and sublethal oxidative stress response.

This demonstrates that a substantial part of plastic products are a potential source of exposure to toxic chemicals.

649 Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio)
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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 (degradation) or weathering (fracturing). The toxicity of microplastics in cosmetics, industries and domestic sources. Virgin plastic polymers are, in principle, biologically inert and thus non-toxic. However, plastic production includes additives such as plasticizers, colorants or fire retardants that can be toxic. In addition to the potential toxicity caused by additives, MPs offer surfaces where 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 models pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebralfish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of PFOS, 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, photomotor response (PMR) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or complete assemblies. Results showed that MPs can be vectors of pollutants which sorbed at the surface over time. The toxicity of MPs as carriers of POPs cannot be demonstrated with 96h of exposure to LDPE microplastics. 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
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Plastic particles within the microns range (microplastics, MP) are increasingly present in marine ecosystems. One of the most concerning aspects of MP in marine
Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)

652 Dissipation of the carcogenic ptauloisole in water resources
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Ptauloisole (PTA) is a natural carcogenic 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 carcogenic 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 water and groundwater has not been studied. Under sterile conditions, dissipation (= hydrolysis) of PTA in aqueous solution follows classical first order kinetics: kobs = k[H+] + kneutral + kalkaline. The rate constants are: kneutral = 25.7±1.0 M−1 h−1, kalkaline = 9.5±6.0·10−4 M−1 h−1 and kalkaline = 4.8±6.0·10−5 M−1 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 environmental 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-stereilised 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 at 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
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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 determination of marine biotoxins, released as a consequence of toxic algal 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 need, it was developed and tested a direct Enzyme-Linked Immuno-Magnetic Capture-Lumino assay for the detection of Domoic Acid, Saxitoxin and Okadaic Acid in seawater. The assay is based on the fact that, in the presence of the target toxin, competition occurs and consequently the color production decreases proportionally to the toxin concentration. This analytical approach allows to combine antibody selectivity, convenience of a separation step through the use of magnetic iron beads and simplicity of the method. Next, the magnetic assay was integrated within a fully automated PC-controlled on-line analyser based on the micro Loop Flow Reactor technology able to host three immunosensor sub-modules. Specific volumes of reagents were injected to a flow cell, equipped with a heater, a magnet and an optical group. Because most of the reagents needed to be kept at 4 °C, a Peltier refrigerated compartment was designed 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 other devices for real-time data analysis. When first toxic outbreaks related to O. cf. ovata occurred in 2005 along the Ligurian coasts (Italy), little was known on several aspects of the phenomenon. Although some Ostreopsis spp. were known to produce congeners of palytoxin (PLTX), O. cf. ovata was not known as a toxic species and its metabolic profile had never been investigated. Secondly, although PLTX itself was reported as one of the most potent protein marine toxins known, and tentatively as the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity non-inhalation. Last but not least, the role 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 Ostreopsis 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-species variability, structure variability, strains variability and detected toxins and, in some cases, linking such differences to the risk that PLTX congeners 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.

654 A decade of chemical studies on Ostreopsis. What’s left?
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Over the last decade massive blooms of the benthic dinoflagellate Ostreopsis cf. ovata, once confined to tropical and subtropical areas, have occurred in more temperate regions worldwide including the Mediterranean Sea. Concurrently, negative impacts on human health mainly due to inhalation of toxic aerosols and/or skin contact with the blooms were observed together with a number of confirmed and suspected fatalities. When first toxic outbreaks related to O. cf. ovata occurred in 2005 along the Ligurian coasts (Italy), little was known on several aspects of the phenomenon. Although some Ostreopsis spp. were known to produce congeners of palytoxin (PLTX), O. cf. ovata was not known as a toxic species and its metabolic profile had never been investigated. Secondly, although PLTX itself was reported as one of the most potent protein marine toxins known, and tentatively as the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity non inhalation. Last but not least, the role 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 was integrated with a communication module for real-time data analysis 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 Dies 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 Centre; N. Sellares, Universitat de Vic Universitat Central de Catalunya / Centre d'estudis dels Rius Mediterrans; J. Colon, S. Ponsas, 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 creates a 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 and supply chain problem, since they cannot predict its appearance and have to act when customers complain.

The aim of this study is to evaluate the relationship between physiochemical 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, depending on the potential geosmin 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 seasonality in the occurrence of cyanobacteria, with 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


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 drafted 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 concentrations and cyanotoxins' concentration within higher in winter (32 ng/l).

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 implementation of specific guidelines with a transparent scoring system applicable to the identified emerging issues in order to prioritize 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

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According to the Regulation (EU) no 283/2013, setting out the data requirements 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 EAT5 (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 EAT5 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 extrapolation among oviparous vertebrates is scientifically justified e.g. in the case of the steroidogenesis pathway leading to reproductive dysfunctions (more specifically egg production). 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

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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 watershed with urban influences commonly contained steroid estrogens, BPA, alklyphens, pharmaceuticals and personal care products. Agricultural influenced sampling sites contained herbicides and pesticides in addition to BPA and alklyphens, 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
plasma and liver cells exhibited toxic stress response. Canonical correspondence 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 meaningful concentrations enhanced fecundity in the F2 and >3 generations, while higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicate that CECs in Great Lakes tributaries may impact fish population health and sustainability.

660 AOP-informed assessment of Endocrine Disruption in freshwater crustaceans
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A number of exogenous compounds have the potential to interfere with the endocrine system of animals and may perturb vital endocrine processes to a degree causing an adverse effect (outcome) on ecologically relevant endpoints such as growth, development and reproduction. These endocrine disrupting (ED) effects have been well characterised in aquatic vertebrates and mammals due to well-defined endocrine system and substantial research effort in the last decades, but knowledge on ED effects in a larger range of species are still poorly characterized. Lack of knowledge on ED effects in invertebrates is currently a major limiting factor to properly perform risk assessment of endocrine disrupting chemicals (EDCs) across taxa. The present project has focussed on developing Adverse Outcome Pathways (AOPs) for EDCs in aquatic crustaceans, and applying these to assess the hazard and risk of ecologically relevant complex mixtures of pollutants. Although several ED mechanisms have been proposed to be of relevance for crustaceans, perturbations of endocrine processes related to chemical interactions with the ecdysone receptor (EGR) and the Juvenile Hormone (methyl farnesoate) receptor (MR) have been identified to be potent endocrine disruptors. The present paper focus on the application of AOPs to 1) develop linkage between endocrine mechanisms and adverse outcomes, 2) identify knowledge gaps and inform testing strategies, 3) identify sensitive species/taxa, 4) identify likely define toxicity endpoints suitable for Integrated Approaches for Testing and Assessment, IATA, 5) identify potential EDCs and 6) practical implementation of AOP in the ESD framework. The focus has been on ecdysone receptor (EGR) and the Juvenile Hormone (methyl farnesoate) receptor (MR) to define EC endpoints suitable for Integrated Approaches for Testing and Assessment, IATA.
664 A Tiered Approach for Screening Chemicals for Biomagnification Potential in Sediment

S. Sangion, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology. P. Gramatica, E. 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 aquatic species diversity of air-breathing organisms have led to Kow and Koa being the primary screening criteria for bioaccumulation assessment. However, primary biotransformation rate constants (kH) and half-lives (HLH) 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) mode is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13. W. Nichols, U.S. EPA / ORD NHEERL Mid Continent Ecology Division; B. Wetmore, U.S. EPA / National Exposure Research Laboratory; J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Despite the fundamental value of biotransformation information, relatively few methods included compiling physical-chemical property data (e.g., Kow and Koa) only to more realistic assumptions for, internal distribution, chemical properties and biotransformation of sediment. The ensuing data quality scores (e.g., high or low confidence) may help 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 behavior may add model uncertainty to predictions of bioaccumulation and trophic transfer.

665 Critical Evaluation of a Human In Vitro Biotransformation Rate Database: Case Study of Seven Chemicals

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Theoretical and Applied Ecotoxicology; E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology; T. Lackenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology

The experimental data was transformed into 3,4-dichloroaniline (3,4-DCA) in the developing zebrafish embryo (Danio rerio) for 3,4-DCA and 3,4-DCA mitigating the compounds’ toxicities? Information on these aspects is valuable for the understanding of the toxicity of phenylamide herbicides to fish embryos. For determining tissue concentrations after different times of exposure, freshly fertilized zebrafish eggs were exposed to the EC20,0, i.e., for diuron, 2.86 mg/L and for 3,4-DCA 1.41 mg/L pools of 7 embryos were shock-frozen at 13 time points from 1.5 to 120 hours post fertilization (hpf). The test compounds were extracted from the embryo tissue with MeOH/H2O and quantified using liquid chromatography coupled mass spectrometry (LC/MSMS). Depuration of test chemicals from the embryo tissue was examined in five different developmental stages of embryos that upon exposure to chemicals were transferred to clean medium and then sampled after 0.5, 1.5, 3.6 and 24 h. The tissue concentrations for diuron reached Tmm, around 48 hpf, Tmm for 3,4-DCA was between 8 and 24 hpf. Based on the data for internal concentrations upon different exposure times uptake and elimination rate constants (k, k) were determined. Both elimination rates and residual of initial concentration after 24 hrs. of depuration differed between embryo stages. The search for possible metabolites showed that 3,4-DCA was transformed into 3,4-dichloroacetaldehyde in the embryo and two products of N-demethylation of diuron were found. This confirms that both phase I and phase II metabolic enzymes in liver and gut epithelial cells of the zebrafish embryo at this early stage.

666 Sediment-associated cyclic volatile methylsiloxanes: Biotransformation in a freshwater oligochaete and an estuarine polychaete

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Chemical regulatory legislation of organic contaminants is generally based on an assessment of the chemical potential to persist (P) in the environment, bioaccumulation (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 overestimate bioaccumulation of 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 organisms may be able to metabolize organic contaminants (i.e., biotransform), 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 teleta and the freshwater oligochaete, Tubifex tubifex. This presentation will illustrate that 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 behavior may add model uncertainty to predictions of bioaccumulation and trophic transfer.

667 Toxicokinetics and biotransformation products of diuron and 3,4-DCA in the developing zebrafish embryo (Danio rerio)

E. Jarosz, UFZ Leipzig / Bioanalytical Ecotoxicology; M. Kraus, Helmholtz centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology; E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology; T. Lackenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology

The development of PBTK models, (ii) Development of PBTK models for environmental risk assessment (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) mode is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13. W. Nichols, U.S. EPA / ORD NHEERL Mid Continent Ecology Division; B. Wetmore, U.S. EPA / National Exposure Research Laboratory; J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Despite the fundamental value of biotransformation information, relatively few methods included compiling physical-chemical property data (e.g., Kow and Koa) only to more realistic assumptions for, internal distribution, chemical properties and biotransformation of sediment. The ensuing data quality scores (e.g., high or low confidence) may help 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 behavior may add model 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.

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**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. Krolh, University of Calgary / Dept. of Ecosystem & Public Health, Faculty of Veterinary Medicine; J. Muscattelo, Lorax Environmental Services Ltd; J. Smits, University of Calgary / Ecosystem & Public Health Faculty of Veterinary Medicine


Diluted bitumen (dilbit) transported from the oil sands in northern Alberta, consists of a mixture of chemicals, such as aromatic hydrocarbons, metals and other compounds, which may pose risks to wildlife and human health, if spilled into the environment. There is a major knowledge gap regarding remediation of oil spills into freshwater environments. The relative efficacy of different remediation strategies for these spill emergencies are untasted. We have established an in situ amphibian assay to serve as an indicator of health and recovery in freshwater ecosystems, which can be applied to assess risk and remediation efficacy. In spring 2017, Wood frog tadpoles were placed in 5, partially submerged cages (50 animals/cage), which were tethered to the peat-organic shoreline of Lake 260 of the International Institute for Sustainable Development-Experimental Lakes Area (ISID-ELA), Ontario, Canada. Tadpoles were fed and monitored every other day and were euthanized when >50% reached their metamorphic climax (the day of forelimb emergence), to perform gross anatomical examinations, sample collection and relevant biochemical analyses. Major outcomes: 1. Time to metamorphosis (an established, sensitive biomarker) 2. Mortality rate 3. Morphometrics (total body mass, length and hepatic mass) Analyses: 1. Hepatic detoxification effort (ethoxyresorufin-O-deethylase (EROD) enzyme activity); 2. Thyroid hormones levels (sensitive biomarkers of endocrine disruptors); 3. Triglyceride levels (reflecting body condition & energy stores). 4. Tissue contaminant levels (metals, PAHs) Baseline data for Wood frog development in Lake #260 were acquired in 2017, and potential pitfalls and solutions for the metamorphosis assay were identified. This assay will be used in the 2018 field season with the experimental shoreline dilbit spills and remediation strategies planned at Lake #260 at the ISID-ELA. In keywords: oil spill, endocrine disruptors, metamorphosis, Wood frogs

MO002
APPLICABILITY OF RISK BASED, TIERED ASSESSMENT OF PRODUCE WATER DISCHARGE IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT
M.G. Smit, Shell International; O. Anako, SPDC Nigeria Ltd

The pursuit of excellence in managing risks associated with produced water discharges has led to continuous innovation of internationally acceptable risks assessment tools for determining the risks associated with produced water discharges. This study utilized a structured framework for the assessment of potential risks from water discharges. At the centre of this structure is a comparative analysis of predicted environmental concentrations (PECs) of chemicals and effluents to predicted no effect concentrations (PNECs) of environmental receptors. However, the determination of the likelihood and severity of effects is complicated and based on an integrated evaluation of several Lines of Evidence (LoEs). This study utilized risk-based assessment tools from Shell’s tiered assessment framework for discharges. This framework was developed based on international good practice and includes screening tools that allow for a rapid assessment of discharge properties and associated risks like SPME-PC and Microtox. In addition higher tier tools were applied like two way GCxGC, PETROTOX modelling and several levels of plume dispersion assessment. The objective is to determine the applicability of risk-based practice to the specific shallow offshore discharge, with possible replication to other shallow offshore or near shore discharges in Nigeria. It also assessed if discharges would be acceptable from an international perspective and whether indeed the risks are tolerable and as low as reasonably practicable (ALARP). Results of the assessment indicate that at oil in water levels at or below 25mg/l there is low concern related to the environmental risk of the hydrocarbons in the PW discharge. Phenols and BTX came up as the highest risk contributors but Tier-2 modelling indicated that these substances quickly dissipate after discharge. PETROTOX modelling showed that the hydrocarbon fraction in the PW could not fully explain the observed PW toxicity. This led to a recommendation for qualification and registration of offshore chemicals and identified a need for the alignment considerations of future Biological Monitoring programs to international protocols such as OECD and ISO. Application of smart screening tools (Tier-1) for frequent PBT monitoring to address variability and for tuning and focusing the larger Tier-2 and 3 assessments.

MO003
Assessment of the biological impact of using chemical dispersants to remediate oil spills in different environmental conditions using zebrafish embryos

Oil spills are a global concern due to their capacity to affect wide areas of the ocean and the ecological balance of the subsequent restoration of the ecosystem. Early life stages of fish are especially sensitive to oil spills as they are unable to flee the area and lack mature detoxification systems to withstand the chemicals. They also represent a direct link to population consequences and resilience. The addition of chemical dispersants can facilitate the dissolution of some chemicals present in the oil and make them more bioavailable. In addition, some chemical dispersants have been proven to be toxic chemicals. The impact of crude oil on a specific ecosystem and its recovery potential are determined by the biotic and abiotic elements of the ecosystem such as species composition, temperature, oxygen level and salinity. At low temperatures the persistence of hydrocarbons in the environment increases. Based on the standard OECD test with zebrafish embryos, we have tested the toxicity of the chemical dispersant FINASOL OSR52 and of the water accommodated fraction of a napthenic North Sea crude oil produced with dispersant (WAFOSR) or without dispersant (WAFOSR) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAFOSR or WAFOSR-D and then used as passive dosers. Exposure to the dispersant caused 100% of mortality at concentrations ≤50 mg/L. Increased prevalence of malformations was observed at concentrations ≥10 mg/L for WAFOSR and WAFOSR-D resulted in a greater embryo mortality than the exposure through PDMS sheets. Significant differences were observed in hatching rate and in the prevalence of malformations of embryos exposed to WAFOSR and WAFOSR-D produced in different conditions. Although no clear differences were observed in relation with the temperature production of WAFOSR or WAFOSR-D, in general greater survival and less malformations were observed in embryos exposed to WAFOSR-D than to WAFOSR-D. Zebrafish embryos appeared as a good model to study the toxicity of WAF depending on the temperature and on the addition of chemical dispersants. Funded by the EU H2020-BG-2005-2 project GRACE (grant agreement #679266), Spanish MINECO (NACE project CTM2016-81130-R) and MECED (FP7 grant to A.E.), the Basque Government (consolidated research group IT810-13) and the University of the Basque Country (UIT13/37).

MO004
Behaviour and effects of a marine diesel oil in a semi-continuous exposure experiment using mussels (Mytilus spp.) from the Baltic Sea
R. Reunamo, Finnish Environment Institute, SYKE / Environmental Research Centre; A. Ahvo, Finnish Environment Institute / Marine Research Centre; H. Kankaanpää, A. Reunamo, K.K. Lehtonen, K.S. Jørgensen, Finnish Environmental Institute / Marine Research Centre

Marine diesel oil is produced and transported in large volumes in the Gulf of Finland and also used extensively as fuel in marine traffic in the Baltic Sea area. The heavy intensifying marine traffic in the area increases the occurrences of smaller spills and leads to higher risk of major oil spills, which would certainly have drastic consequences to the local ecosystem. Chemical composition, mainly the polycyclic aromatic hydrocarbons (PAHs), can be more variable between the different diesel fuels, affecting the toxicity of the diesel to exposed marine organisms. The aim of this study was to determine the changes in the concentration of PAHs in water, accumulation of PAHs, and a battery of biomarkers (embryo lethality, growth and WAF treatments were renewed every two days. Changes in PAH concentrations in water were constantly quantified using a TriO5 Environfluo HC-500 fluorometer sensor. Another sensor was used to collect auxiliary data on temperature, turbidity and chl a concentration. Biochemical markers of oxidative stress, biotransformation, neurotoxicity and bioenergetics were measured from mussels after a one week recovery period in clean water. Water and mussel tissue samples were also taken to chemical analysis of PAHs. Based on the sensor fluorescence data the initial PAH concentrations were ca. 30µg/L in WAF-high and 15µg/L in WAF-low treatments. In a semi-static system with mussels the concentrations decreased during 24 hour after which the level remained stable until the next water exchange. During the recovery period PAHs occurred in water after every water exchange, suggesting significant release of PAHs from mussels (both from shell surfaces and internal pools). Differences between the treatments were observed in various biomarkers measured. Combined fluorescence, chemical and biomarker data give important insights to the fate and toxic effects of marine diesel oil in the northern Baltic Sea environment.

MO005
Biliary PAHs and enzymatic biomarkers in the teleost Eugeois brasiliensis along four tropical estuaries in the Brazilian Northeast
J.S. Silva, R.N. Alves, UFPE - Universidade Federal de Pernambuco / Zoology;
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.C. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; A.D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; M. Lambi, 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 were detected in the sample. Furthermore, the study involved the use of bioaccumulation potential of these substances, 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 administered in fish in the diet either daily or every other day to minimize growth dilution and limit vertebrae use. Chemical and lipid analysis were performed on diet and fish tissues at different sampling times. Results were used to calculate substance-specific lipid-normalized biomagnification factors, dietary assimilation efficiencies and growth-corrected eliminated rates. Comparison of experimental results to model predictions for non-metabolizable chemicals was used to infer the role of tissue and gut bioaccumulation in mitigating observed bioaccumulation. This study provides new data to inform bioaccumulation assessments of heterocyclic compounds and to support development of quantitative structure-property relationships for improved bioaccumulation prediction of sulfur and nitrogen containing compounds.

MO008

Biological Markers and Gene Expression Variability in Perch in Reference Sites Used for Biomonitoring Studies

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Perch (Perca fluviatilis) has been used in biological effect monitoring of point 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 offer the possibility to follow variations in biological parameters associated with natural processes and increased baseline pollution. The data sets also showed relatively large variations between years. To further investigate these trends and to identify candidate biomarkers specific lipid and marine waters...
Marine Biology and Biotechnology PIEUVHEU

Biomarker approach has been widely used in mussel monitoring programs for several years. However, up to now it has not been commonly used in high latitude study areas. In order to establish reference values of cellular and tissue 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 collected 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 alveoli (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 were measured in gill tissue. Ultrastructural response to paracryplastic 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 parasitization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the parasitized sites than in reference sites in both study areas. Lysosomal and lipofuscin are a risk to mussel health. The small size of the oil spills 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 in the marine environment. *Funded by EU H2020 GRACE Project (Grant Agreement Number 679266), Basque Government (IT18013-19) and UPV/EHU (UFI 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.).

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Oil pollution coming from accidental oil spills and from activities related to oil production is a serious threat to marine environments. The acute and chronic effects of oil spills 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, such 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 OSR 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, 2.5, 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 (1.25, 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, 50 and 100% WAF (p<0.05) (10°C), but no differences were found at 12.5, 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 alone 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 NAGE project (CTM2016-81130-R), Basque Government (consolidated research group IT810-13) and UPV/EHU (UFI 11/37).

MO011

Determination of inorganic cations and amines in wastewater, surface water, and neutralizing amine solutions by IC coupled with a single quadrupole MS


Inorganic cation and amine determinations are important to assess salt build-up in 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 methyldiethanolamine) are used routinely to prevent corrosion during transportation to the refinery or to remove sour gases during the refining process. Pressing plants require accurate monitoring of structural changes in the endo-lysosomal system (LSC) of digestive cells were also determined. Higher VvBAS values were recorded in polluted sites than in mussels from reference sites in both study areas. Moreover, mussels from impacted sites exhibited elevated atrophy of the digestive alveoli (high MLR/MET values) and retraction of digestive diverticula resulting in apparently higher relative extent of interstitial connective tissue (high CTD values). In addition, occurrence of oxidative stress, paracryplastic 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 parasitization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the parasitized sites than in reference sites in both study areas. There is a need to develop efficient tools to assess the risks of oil pollution and of oil spill response strategies, such 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 OSR 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, 2.5, 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 (1.25, 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, 50 and 100% WAF (p<0.05) (10°C), but no differences were found at 12.5, 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 alone 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 NAGE project (CTM2016-81130-R), Basque Government (consolidated research group IT810-13) and UPV/EHU (UFI 11/37).

MO012

Distribution and ecological risk assessment of palm stearin in coastal marine environments of Hong Kong during an accidental pollution in Pearl River Estuary, South China

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On 3 August 2017, two container vessels collided in the Pearl River Estuary, southwest of Hong Kong, leading to release over 1,000 tonnes of palm stearin into the marine environment. In the following four months after the incident) in six locations along the south coast of Hong Kong; determine its toxicities to selected marine organisms including microalga (Isochrysis galbana and Chaetoceros gracilis), the copepod (Tigriopus japonicus), the MS (Mytilus galloprovincialis), and the no-observed-effect level (NOEL) of the palm stearin, and derive interin water quality guidelines (WQG) of the palm stearin and thereby assess its ecological risks to local marine ecosystems. Samples of the palm stearin, surface seawater, sediment and three intertidal gastropods were collected twice (within seven days and four months after the incident) in six locations along the south coast of Hong Kong. Fatty acids in these samples were detected using gas chromatography and mass spectrometry. Standard toxicity tests were conducted with Artemia franciscana, Oryzias melastigma, and Chaetopterus variopedatus, the use of larvicidal oil is the most common way being employed in mosquito control. The University of Hong Kong; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science an

K. Yeung, The University of Hong Kong / K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science.

MO013

Ecological impacts of larvicidal oil on the marine ecosystem: implications on its management

K. Yeung, The University of Hong Kong / K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science.

Mosquitoes are some of the most influential insects to mankind in the world due to their ability to transmit diseases to humans, resulting in millions of deaths every year. Prevention of mosquito-borne diseases and elimination of mosquitoes is important to protect human health. Among different methods of eliminating mosquitoes, the use of larvicidal oil is the most common way being employed in Hong Kong. However, larvicidal oil will be eventually released into the marine environment...
MO014 Effects of a coastal oil spill on marine invertebrates and their potential to recover
M.F. 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 caused 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 biomarkers were evaluated. For this purpose, the occurrence of energetic trade-offs, potential recovery, and even which species to use is still deemed for an effective environmental contamination assessment. The guppy (Poecilia reticulata), a native species with a broad tropical distribution, was used as a relevant tool to determine the impact of PAHs on the marine ecosystem. Its biological and ecological characteristics make it a suitable species for monitoring and assessing the impact of environmental pollutants, particularly PAHs. The results showed that the guppy was sensitive to PAH exposure, as evidenced by changes in hematological, biochemical, and histological parameters. The findings highlight the importance of considering the use of appropriate models, such as the guppy, for assessing the impact of PAHs on marine ecosystems and for informing effective management strategies. MO015 Effects of oil exposure on visual function in early life stage fishes
J.T. Magnusson, University of North Texas / Biology; A.J. Klurisgara, The University of Texas at Austin / Marine Science Institute; E. Allmon, The University of Texas at Austin; A. Esbaugh, University of Texas Marine Science Institute / Department of Marine Science; R.M. Heuer, University of Miami / Marine Biology and Ecology; J.D. Stiegitz, M. Grosell, 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. The effects of oil spills on marine life, particularly on early life stages, are of great concern due to their high sensitivity to environmental stressors. In this study, the visual function of early life stage fishes, including the guppy (Poecilia reticulata), was assessed after exposure to oil. The results showed that oil exposure had a significant impact on the visual sensitivity of the guppy, as evidenced by changes in visual acuity and pupil diameter. These findings highlight the importance of considering the effects of oil spills on the visual function of early life stage fishes and the potential implications for marine ecosystems. MO016 Objects of oil spill on coastal seaweed in the Arctic
S. Wegeberg, Aarhus University / Department of Bioscience; J. Fritt-Rasmussen, K. Gavstov, 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 resolved. 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 ecological risks, the effects of oil spilling 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. All oil types were characterized by gas chromatography-mass spectrometry. The concentrations of larvicidal oil were determined with the range from 6.92 mg/L to 53.89 mg/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 macroalgae Isochrysa 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 latipes. Our results showed that although all test marine species were not very sensitive to larvicidal 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 of a hazardous quotient > 1 from exposure to larvicidal oil using Monte Carlo simulation, indicating that the current risk was unacceptable high. Hence, monitoring and control on the use of larvicidal oil as mosquito control pesticide would be urgently needed to mitigate its ecological risks. 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. Reunamo, 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 method of dispersant application under harsh weather conditions is not well studied. In the present study, impacts of a crude oil and the dispersant Finosal 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 North Sea crude oil in a semi-sterile 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 acetylhilinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonylation. 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-D 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-D with 44 mg/l oil at 5.6 and 1.82 mg/l 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 for biodegradation of oils 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 on the estuarine guppy Poecilia vivipara to monitor two Integrated tropical estuarine ecosystems
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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...
and resident individuals (RES) collected close to the mouth of two tropical estuaries, Bacia do Pina Estuarine System (BIES), and Barra de Jangada Estuarine System (BJES), in the Brazilian northeastern coast. This study is based on the analysis of water concentrations and internal accumulation of bile metabolites of polycyclic aromatic hydrocarbons (PAHs) by fixed fluorescence (FF), as well as biochemical responses related to the biotransformation of contaminants etoxyresorufin-O-deethylase (EROD) and aryl hydrocarbon hydroxylase (AHH). 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 birds at BIES, which in turn partially justified the significant induction of EROD and GST in these individuals. Resident bird 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 guinea P. v. variegatus on the evaluation and monitoring of pollution in estuaries along the Brazilian coast.

**MO019 NEW METHODOLOGY TO DETERMINE BTEX IN SOIL SAMPLES BY HPLC-DAD**

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-Benzene, toluene, ethylbenzene and xylene, commonly referred as BTEX, are constituents of fossil fuels and are sensitive to the environment and human health. At fuel stations whose 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 water acidified with 250μL of H3PO4 (70:30, v/v), an Eclipse 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 diode array detector and a column oven, with a data acquisition using OpenLAB DAD 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 ethylbenzene and 1 to 85 for xylene. The curves were submitted to between- and intra-assay repeatability analyzes. 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 sample. In the solutions 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 analyzes 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.

**MO020 Petroleum pollution of alluvial sediments near Sava river, Serbia**

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Heavy oil "New Belgrade" is located on the left coast of the Sava River, about 1km 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 overall environmental risk, and will feed directly into the PWMP. Notably in the UK RBA methodology is the absence of a 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 risk of the discharge with the recommended criteria. A Produced Water Management Plan (PWMP) must be adopted to comply with the RBA regulatory requirements. Processing the information generated by the RBA, each PWMP would be specific to the discharged effluent, platform and area, aiming to minimise environmental risk of each PW discharge. The RBA methodology is a six-step process. The steps are based on a standard method where a Predicted Environmental Concentration (PEC) and a Predicted No Effect Concentration (PNEC) of the PW or individual products are determined, and a PEC/PNEC ratio is calculated. The PEC/PNEC ratio and Environmental Impact Factor (EIF) which describes a PEC/PNEC ratio in a specified volume of water determine the environmental risk can be mapped specifically to the installation area providing an overall risk profile. The PW is additionally characterised at a substance level, highlighting components which contribute to the overall environmental risk, and will feed directly into the PWMPs. Notably in the UK RBA methodology is the absence of a Risk Based Approach: Assessment of Offshore Discharge Waters. In addition to the potential environmental impact and comparative contribution from production chemicals & naturally occurring substances, and validity of the step-wise tiered screening approach, the investigations provided valuable assessment into adequacy and sensitivity of ecologically relevant species and the implications for regulatory monitoring regime.
Risk-based assessment of produced water discharges - need for alignment
M.G. Snijt, 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 Reasonably Practicable). 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 modeling, 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, the other might apply 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.

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) were measured in nautical coastal waters and analyzed from 23 stations since 1984 from Kuwaiti coastal waters. Here it was investigated whether concentrations of these determinants 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 to observe this significant increase over time for Cd and Hg. 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.

Temperature-dependant toxicity of Napthenic North Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays
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Maritime traffic and oil platforms in the North and Baltic Sea have been growing during the past years. The risk of spill oil and the risk of spill oil related work is driven by 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 given different range of temperature have not been deeply explored yet, to our knowledge. Thus, as a part of a European project called GIBUS the aim of the present work was to assess 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, EC50 values were calculated and length of larvae was measured 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 larvae 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 OSR52 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 our study, larvae abnormalities and reduced larval growth indicate that toxicity was lower in crude oil WAF than in dispersant 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 FPUs15/053117) and the Basque Government (Consolidated Research Group GIC10T13-10).
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 monitored 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 within the EU-funded Marker survey, a new drug algorithm project to provide Column 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 the data set interesting for testing the interpretation capability of the approach. At the site with no discharge of PW at the time of the sampling, contamination by drill cuttings were the 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

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The brackish 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 biota. 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 Tvarminne (Finland) in November 2016, taken to laboratory facilities and acclimatized 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 part of the sea is more easily impaired than in those inhabited the more saline southern regions. The current study is among the first to present a data from the latest surveys in the biomarker based approach to provide assessment criteria for biomarkers, and for the performance of the biomarkers as risk indicators in relation to assessed environmental risk.

MO030

Toxicity of produced water from offshore oil production in Norway and corresponding polar and apolar fractions

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Regulation of produced water (PW) discharges on the Norwegian continental shelf is largely based on a maximum 0.0% toxicity may be accepted, with cover, rounds of conventional oil quantification methods based on traditional GC is limited when it comes to polar compounds that originate from produced crude oils. Furthermore, the use of treatment or production chemicals might also contribute to the overall PW toxicity. As a result, there may be discrepancies between measured concentrations of organic compounds and the total PW compounds that contribute to toxicity. A combination of all collected and characterized PW was used from four oil platforms on the Norwegian continental shelf. PWs were collected 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 PW 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 compounds analysis). For the total PW extract, 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 study therefore indicates that apolar compounds are most frequent in the oil. Partial fractions may contain compounds not amenable to GC, or that contribute to the GC–based quantification of oil in water. 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

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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 species. The central role of the oil component branched hydrocarbons (BHCs) in the toxic chain, 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 stagecopepode third (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 was replaced every 24 h as well as biometric and histopathological measurements. The crystals 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 CILLs, 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 CIIIs and the lipid-rich CVs. For the
Wildlife ecotoxicology: laboratory dosing studies to field

MO035
Seabird-derived contaminants and genotoxicity in Collemboila from the Arctic
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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 (Collemboila) contribute to a high proportion of the local biomass and therefore play a vital role in the recycling of contaminants such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collemboila. Two Collemboila 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, Collemboila 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 overall, 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 Collemboila 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 Collemboila and habitat. DNA fragmentation was higher in Collemboila 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 Collemboila and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both Hg and contaminants, increasing 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
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The Antarctic ecosystem has been considered low. However, recent investigations have shown that south polar skuas (Catharacta maccormicki) has the highest levels of biomagnifying contaminants among Antarctic seabirds. The present study quantifies OHC levels in south polar skua blood, and evaluate associations between contaminant occurrence, diet, trophic position, biological variables and day of sampling. Furthermore, this study investigates temporal change of organochlorine contaminant (OCs) by comparing with previous data from the same colony, collected during the season of 2001/2002. South polar skuas were sampled during the breeding season of 2013/2014 in Svarthamaren, Drønnning Maud, Antarctica. Whole blood was analysed for 87 OHCs of which 56 were detected. Stable isotope ratio of carbon (δ13C) and nitrogen (δ15N) were measured to determine碳 source and relative trophic position, respectively. In 2013/2014, predominant contaminants were Mirex (8484 ng/g lw) and Hexachlorobenzene (HCB) (3561 ng/g lw). These levels were higher than those reported from other south polar colonies and Antarctic seabirds at similar ecological niches. Multivariate analysis indicated that skuas sampled late in the breeding season had higher contamination of perfluoralkyl substances (PFASs) and lower relative contribution of ΣPCBs, levels increased with concentrations of lower polybrominated diphenyl ethers (PBDEs). Due to low intraspecific variance in δ13C and δ15N, no significant associations were found between OCs and isotope ratios. However, lack of associations could also be due to influence of migration, wintering habitat and different turnover rates in OHCs and isotypes. Skuas from 2013/2014 had significantly higher concentrations of most OCs and a lower body condition than skuas from 2001/2002. ΣPCB, Mirex and HCB increased with 105%, 40% and 60%, respectively, between 2001/2002 and 2013/2014. Ratios of Mirex/ΣPCB and Mirex/HCB decreased between the two seasons, suggesting stabilizing Mirex levels and possibly declining levels in the future. Further studies should elucidate the effects of wintering grounds and diet, as well as the level and contaminant occurrence in Antarctic Petrel (Thalassia sect. Antarctica), the main prey

MO034
Using the hagfish (Myxine glutinosa) to study biological effects of a wreck filled with chemical munitions
A. Ahvo, Finnish Environment Institute / Marine Research Centre; H. Niemioksi, Finnish Institute for Verification of the Chemical Weapons Convention / Department of Chemistry, University of Helsinki; K. Straumer, Thünen Institute of Fisheries Ecology; J.A. Tørnes, Norwegian Defense Research Establishment; P. Vähäkangas, Finnish Institute for Verification of CWC 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 intentionally sunk and are still laying on the deep bottoms (ca. 600 m) as well as two west of Denmark. In these complex compounds in environmental matrices. In this study, the separation and quantitation of organochlorine congeners in the hagfish (Myxine glutinosa), a sediment-dwelling chordate, was selected as target organism for acetylcholinesterase activity and for histopathological biomarkers, and muscle tissue was analyzed for acetylcholinesterase 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 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.

MO033
Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples
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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 quantitation of organochlorine congeners in samples with high chlorinated contents. The lower slope for CV signifies that storage lipids are less well stabilized Mirex levels and possibly declining levels in the future. Further studies should elucidate the effects of wintering grounds and diet, as well as the level contaminant occurrence in Antarctic Petrel (Thalassia sect. Antarctica), the main prey

MO034
Using the hagfish (Myxine glutinosa) to study biological effects of a wreck filled with chemical munitions
A. Ahvo, Finnish Environment Institute / Marine Research Centre; H. Niemioksi, Finnish Institute for Verification of the Chemical Weapons Convention / Department of Chemistry, University of Helsinki; K. Straumer, Thünen Institute of Fisheries Ecology; J.A. Tørnes, Norwegian Defense Research Establishment; P. Vähäkangas, Finnish Institute for Verification of CWC 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 intentionally sunk and are still laying on the deep bottoms (ca. 600 m) as well as two west of Denmark. In these complex compounds in environmental matrices. In this study, the separation and quantitation of organochlorine congeners in the hagfish (Myxine glutinosa), a sediment-dwelling chordate, was selected as target organism for acetylcholinesterase activity and for histopathological biomarkers, and muscle tissue was analyzed for acetylcholinesterase 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 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.

Wildlife ecotoxicology: laboratory dosing studies to field
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. Islas-Flores, Estadística de México / Zoología Ambiental; I. Pérez-Alvarez, Universidad Autónoma del Estado de México / 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. Sanjuán-Reyes, Autonomous University of the State of Mexico / Chemistry; O. Dublan-García, Universidad Autónoma del Estado de México / Zoology; J. Chávez-Hernández-Navauro, Universidad Autónoma del Estado de México / Toxicology

Hospital effluents are important from the eco-toxicological 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. In this work it was to evaluate the malformations generated by a hospital effluent of Toluca, in the Estado de Mexico in this species and compare with Xenopus laevis, species that is used as a preferred bioindicator, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose oocytes in mid-blastoelul 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 (TD) 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%, I=3.8) and in L. catesbeianus (EC50=0.351%, LC50=1.431%, I=4.0), the main alterations being microcephaly, cardiac and facial edema, malformations in the eye, notochord, tail, fin and intestine. However, the lightest concentrations (0.1% and 0.2%) of hospital effluent 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. Raffelt, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; R. Triebkom, University of Tuebingen / Animal Physiological Ecology; H. Köhler, University of Tuebingen / 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 sediments samples from the field with the Danio rerio embryo test (Dar-T), including the endpoints mortality, hatching success, heart rate, developmental delays and malformations. (II) Investigation of fish health by histopathology of actively (caged rainbow trout) and passively monitored (caught feral) fish. Results show that the river system – from a biological point of view – is not in a good (as demanded 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 Multigenerational toxicity of Fipronil to Foliosa candida D.d. Oliveira, C.M. Reganhan Concegian, 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 collemboalan Foliosa 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 Foliosa 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 Migelos fairy yams in sugarcane crops (RD = 1.3 mg of the commercial product / kg^(-1) of dw soil), what 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 (i.e. kg^-1 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 Foliosa candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO040 Fipronil effects on freshwater benthic algal communities J. Val, D. Ballestero, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. López-Martinez, A.M. Mainar, Universidad de Zaragoza; M. Pino, San Jorge University / Facultad de 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 (0.63-0.89) (p< 0.001), exposing periphyton to fipronil under standard medium. However, toxicity was almost inexist when assays were done using natural river water. In this last case, the bioavailability of the fipronil was hypothetized 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 organophosphorous insecticides in agriculture lands, in a simple test birds says please no! A.N. HUDD 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 are 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 treatment that is made is of great concern. To assess the impact of fipronil on 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 cholinesterases, 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

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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 sparrows 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 between these two biomarkers and blood non-esterified fatty acids were expected under realistic worst-case field conditions.

MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals in freshwater turtles
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The mobilization of metals from 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) in Central Spain were analysed. The highest levels of blood Pb were found in the animals collected from the area of Valle de Alcudia-Sierra Madrona, more specifically from Solana del Pino, with an average (±SD) of 5.59±3.66 μg/g dry weight (dw). 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 correlation was found between the activity of superoxide dismutase and the highest levels of mercury. The highest levels of blood Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.83±8.84 μg/g dw. These individuals showed no evidences of oxidative stress, but presented increased activity of glutathione peroxidase and reduced glutathione levels relative to the rest of populations, which would indicate that antioxidant system is protecting from a sublethal damage to occur. Blood levels of these two elements were above those reported as susceptible to cause sublethal effects in reptiles for the vast majority of terrapins from the most contaminated sites (100% of terrapins from Solana del Pino with blood Pb levels > 15 μg/gdw; 70.3% from Almadenejos with blood Hg levels > 2.76 μg/g dw). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R ≥ 0.705, P < 0.001), but not for Hg (R ≤ 0.362, P ≥ 0.127). Thus, theses samples could be used as non-invasive methods for the analysis of Pb bioavailability in M. leprosa, and by extension in reptiles, which will contribute to the development of ecotoxicology in reptiles, a group very little studied in this regard.

MO044 An analysis of important life stages, exposure routes and test endpoints in amphibians and coverage by existing risk assessment regulatory requirements for plant protection products, part 1
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Concerns have been raised that the current risk assessment of plant protection products (PPP) may not sufficiently cover the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion addressing the state of the science regarding the risk to amphibians and reptiles exposed to pesticides (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are currently covered (or not) by the current risk assessment paradigm. We had four steps in this analysis: 1) Identify relevant life-stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for amphibians; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/endpoints; 3) Explore whether tests with surrogate species could provide suitable information allowing extrapolation to assess the hazard/risk for amphibians; 4) Identify proposed non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. For amphibians, greater coverage or surrogacy exists for the aquatic larval stage and short term effects, with less coverage of the adult terrestrial stage, reproductive toxicity, and the potential for the potent dermal exposure routes. To cover important life stages, exposure routes and effects, tests addressing dermal overspray and reproductive toxicity in amphibians may be needed. The analysis for reptiles will be presented in a separate poster. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of amphibians within the remit of the PPP authorization.

MO045 European common frog (Rana temporaria) larvae show subcellular responses under field-relevant Bacillus thuringiensis var. israelensis (Bti) exposure levels 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 agent 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) larvae. 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
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Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to rising seawater intrusion. Coastal wetlands are considered sensitive ecosystems and 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.

MO047 Setting the stage for a more integrated approach to the assessment of the applicability of European amphibian and reptile population models
S. Cameron, K. Blair, University of Edinburgh, Centre for Ecology and Hydrology / Department of Zoology / University of Edinburgh; B. Frombold, University Koblenz-Landau / Institute for Environmental Sciences

As amphibians and reptiles are increasingly targeted for conservation, the need for better understanding of their environmental sensitivity is essential. The current approach to these species is predominantly separate, and a more holistic approach is needed. In this presentation, we will discuss an integrated approach to the assessment of amphibian and reptile population models, which will provide a framework for understanding the risk to amphibians and reptiles from climate change and the potential of these models to provide information for conservation decisions.
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 Dendropolithus columbianus (ANURA: HILDAE) TO WATERS CONTAMINATED BY ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES

V. Ramírez Castaño, 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 on exposure of 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 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 (91%), 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 reported 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. Stennis, EFSA / Pesticides Unit; P.J. Adriano, 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 these water bodies for a spawning activity. Some species migrate long distances through fields and some reside in fields and field margins where they can be exposed to pesticide residues in food items, water, soil and plant surfaces. A number of studies indicate that pesticide exposure can lead to severe impacts with up to 100% mortality from overspray at field rates for some pesticides. Dermal exposure was identified as an important exposure route in the EFSA opinion. The aim of the current study was to investigate different options to address the risk from dermal exposure by overspray and contact to soil and plant surfaces. Existing exposure models were reviewed with regard to their suitability for amphibian and reptilian risk assessment. This included comparison of parameters used in model calculations, comparison of sensitivity to dermal exposure and worst case scenario calculations. The aim is to determine if amphibians and reptiles are exposed to greater dermal exposure from overspray and to compare it with exposure from contact to soil and plant surfaces. In addition a novel approach was developed to estimate the uptake from soil and plant surfaces. Mammalian dermal toxicity related to local effects and dermal adorption data may be used as surrogates for reptiles but not for amphibians. The development of a test method investigating local effects on amphibians and reptiles will be as an alternative to the estimation of the body burden following exposure via the dermal route is needed. Comparison of body burden by overspray to body burden by exposure to treated soil or foliage showed that the maximal body burden by overspray was lower than the maximal body burden by passive or active dermal exposure from soil or by contact to foliage. An approach was suggested which could combine oral and all dermal exposure routes in one overall body burden which could form the basis for a realistic risk assessment.

MO049 Evaluating the Role of Fish as Surrogates for Amphibians in Ecological Risk Assessment

S. Glaberman, University of South Alabama / Biology; J. Kwiet, University of South Alabama; C. Aubee, US Environmental Protection Agency / Risk Assessment Division Office of Pollution Prevention and Toxics

Ecological risk of chemical exposure to water-phase amphibians is historically evaluated using surrogate toxicity data from standard fish species. Recently published meta-analyses of aquatic amphibian ecotoxicology data indicate both groups are similarly sensitive to a range of chemicals. However, these analyses are limited because the amphibian data reported in the peer-reviewed literature are variable both with respect to experimental design and test species. In 2010, the U.S. Environmental Protection Agency began receiving ecotoxicity data for a standard amphibian test species (Xenopus laevis) as part of the Endocrine Disruptor Screening Program. Altogether, these data have permitted us to begin to determine a determination of potential thyroid interaction within the context of other endocrine screening studies, they also contain valuable data on survival and growth that can be compared to existing fish data for a given chemical. We used this dataset to compare no observed adverse effect concentration (NOAEC) values for survival, body weight, and length data between fish and amphibians for 45 different pesticide active ingredients. Overall, the results indicate that fish are a reasonably good predictor of amphibian toxicity as there were no statistically significant differences in NOAEC values between the two groups for the endpoints examined. However, toxicity endpoints were lower in amphibians as compared to fish approximately half the time across chemicals, challenging the notion that fish are consistently more sensitive than amphibians. Disclaimer: Disclaimers: The views expressed in the abstract do not necessarily represent the views of the U.S. EPA or the United States.

MO050 Long-term survival of mancozeb exposed common vole populations from one to the following reproductive seasons

F. Von Blankenhausen, J. Lübcke, Rifcon GmbH

Rodent field effect studies relevant for pesticide risk assessment typically take place during crop development from spring to autumn and thus within a single reproductive season. However, animal survival covering multiple reproductive seasons has only rarely been considered. This includes also microtine rodents such as the common vole (Microtus arvalis), as they are considered as rather short-lived vertebrates. However, overwintering individuals are important for the survival of local populations, and potential pesticide exposure during maturation might impact survival during seasonal bottlenecks in winter from one to the next reproductive season. Furthermore, from a regulatory perspective and due to the one-reproductive-season-duration of most field effect studies in wildlife, there is an indirect concern on potential long-term effects from exposure occurring delayed or that the reproduction in the following season might be affected by exposure during a previous application season. Against this background we monitored individually marked common vole populations from a long term effect study on spray applications of Dithane M-45 (Mancozeb 80% WP) during one reproductive season further on into the following reproductive season. The test item Dithane M-45 was applied four times in June according to Good Agricultural Practice at an application rate of 2 kg a.s./ha. Trapping and marking of voles in the same investigation plots was conducted until September, followed by further trapping until spring of the following year and the onset of the new reproductive cycle. Reproductive parameters recorded as indicators of potential long-term effects resulted in very similar patterns in treatment and control plots, and the data show no indication that common voles were negatively affected by multiple application of the test item also in the following year. Furthermore and up to now not documented for wild living common voles, the data gives evidence that free-living common vole individuals can reproduce for more than one reproductive season.

MO051 An analysis of important life stages, exposure routes and test endpoints in reptiles with regard to coverage by existing risk assessment regulatory requirements for pesticides

A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Upssala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santana, Institute for Game and Wildlife Research (IREC) / UCLM-CSIC-JCCM; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; S.M. Weir, Queens University of Charlotte / Biology

Concerns have been raised that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion for amphibians and reptiles (EFSA 2017) that the working group was to understand how well important life stages, exposure routes and endpoints are currently covered (or not) by the current risk assessment methodology. We had four steps in this analysis: 1) Identify relevant life stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for these groups; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/effects; 3) Explore whether tests with surrogate species could provide suitable information allowing for extrapolation to assess the hazard/risk for amphibians and reptiles; 4) Identify proposed
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 eggs 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 currently 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 in scientific circles 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. Species in terms of physiology (e.g., permeable skin) and ecology (aquatic, terrestrial life-stages in different seasons) and their microhabitat patterns (and habitat preferences) make this taxon in particular vulnerable to pesticide applications 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 gap on terrestrial life-stage data on European anurans 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 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
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Differences in sensitivities to chemicals among species and taxa is a major challenge for accurate ecological risk assessments. Most toxicity information is collected for a few model species and little is known about the relationship between the sensitivity of the model species compare to non-model species. Quantitative adverse outcome pathways (qAOPs) are quantitative, biologically-based models which describe key event relationships that link a molecular initiating event to an adverse outcome. qAOPs can be used as a service tool to determine the relationship between the sensitivity of chemicals with a molecular initiating event and an adverse outcome among species. Previously, a qAOP had been described for the indirect relationship between activation of the aryl hydrocarbon receptor (AHR) by dioxin-like compounds (DLCs) and embryo-mortality in birds and fishes. It was hypothesized that this qAOP was also applicable to amphibians and reptiles. However, little is known about whether the sensitivity to activation of AHR is predictive of sensitivity to DLCs of embryos of any amphibians or reptiles. Therefore, in order to test the hypothesis of applicability to amphibians and reptiles, this study investigated sensitivities to activation of AHRs in an in vitro transactivation assay. This assay was run on an amphibian, the African clawed frog ( Xenopus laevis), and a reptile, the common snapping turtle (Chelydra serpentina). Embryo-mortality was assessed in African clawed frog embryos exposed to serial concentrations of one of two DLCs: 2,3,7,8-tetrachlorodibenzofuran (TCDF) or 2,3,4,7,8-pentachlorodibenzofuran (PeCDF). Embryo-mortality was assessed in common snapping turtle embryos exposed to serial concentrations of one of four DLCs: TCDF, PeCDF, 3,3',4,4',5-pentachlorobiphenyl (PCB 126), or 2,3,7,8-tetrachlorodibenzo-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 vivo 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.

MO054
Do historically metal-exposed amphibian populations acquire resistance to lethal levels?
A. Esola, University of Coimbra; M. Ortiz Santaluzela, Institute for Game and Wildlife Research (ICREM) UCLM-CSIC-JCCM; J. Pareja Carrera, ICREM-UCLM / Institute for Game and Wildlife Research (ICREM) UCLM-CSIC-JCCM; 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 mentioned 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 mg 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. 63.9-138.6 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 µg/g, from Pb site 118-491.6 µg/g; Pb-exposed: from reference site 369/97-9476.0 µg/g from Pb site: 9043.5-78452.4 µg/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 in controlled conditions for 20 days represented but small part of the oxidative stress induced in the laboratory (105.99-138.66 vs 29.72-41.70 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.

MO055
Assessment of metal contamination levels and stress responses of endangered sea turtles of São Tomé and Príncipe
I.P. Morão, S.C. Novaes, Polytechnic Institute of Leiria / MARE ILeiria; I. Vieira, A. Malheiro, Institute for Environment, Science and Technology JCCM; R. Ribeiro, Universidade de Coimbra / Life Sciences; M. F. Lemos, Instituto Politécnico de Leiria / MARE ILeiria
São Tomé Island harbors important sea turtle nesting and feeding sites. However, insufficient enforcement of environmental laws to avoid illegal take of nesting females and eggs, associated with a great lack of knowledge about how these species interact with their environment and how human activities impact their survival in the region, constitute significant challenges for sea turtle conservation. Through current local conservation projects, some information on genetics and nutrition of sea turtle populations is being unveiled but very little is known about how local pollution is impacting endangered turtles. This work had the objective of this study was to assess the metal contamination accumulated by two species of Tomé sea turtles (Eretmochelys imbricata and Chelonia mydas) and infer about possible impacts of such contamination on their general stress responses and health status. More specifically, the final goal was to find correlations between metals in their tissues and the expression of key genes involved in detoxification/sequestration and metal transport, antioxidant responses and oxidative stress, immunological responses, mitochondrial respiratory and energy production, among others, which could be indicative of these organisms health and future viability. To achieve these goals, nesting female turtles were sampled for blood and skin tissues, immediately after egg laying in their well-documented spawning sites in S. Tomé. Skin samples were collected from the right front flipper of the turtles and stored at -20°C until analysis of metal concentrations. Blood samples were withdrawn from the external jugular vein and stored in RNAlater at -20°C until RNA extraction and gene expression analysis using quantitative real-time PCR (qPCR). Additionally, body mass and carapace length were also recorded, along with all information regarding

SETAC Europe 28th Annual Meeting Abstract Book
MO056  
Ecotoxicology of Africa's three largest reptiles: POPs, metals, eggs, and eggshells.  
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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 cannot 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 cadmium concentrations were monitored in relation to POPs for each species. The results showed some populations historically exposed to increasing levels 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 mM/cm² for seawater and NaCl, respectively). As well, for the sub-lethally-impacted endpoints (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.

MO057  
Improving knowledge flow: from conservation to management.  
L. Villamar Bouza, European Food Safety Authority / Pesticides; D. Govender, SANParks; M. Du Preez, North West University / Zoology.

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 relation to its input of pollutants to 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 mM/cm² for seawater and NaCl, respectively). As well, for the sub-lethally-impacted endpoints (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.

MO058  
Increasing salinisation effects on P. perezi populations - Could historical exposure drive effects?  
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 climatic extremes. Additionally, Intergovernmental Panel on Climate Change (IPCC) reported alarming projections for sea levels rise at 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 historically exposed to environmental and levels 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 h-10) were exposed for 96h, and to what concerns to the input of pollutants to 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 mM/cm² for seawater and NaCl, respectively). As well, for the sub-lethally-impacted endpoints (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.

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.

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MO060  
Estrogeic effects of an Organophosphorus Flame Retardant (TCP) on Edible Sea Urchin "Paracentrotus lividus".  
P.C. Lóquez, 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).
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-Methyl-ethyl) Phosphate (TCP), 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 TCP as an endocrine disruptor on the edible sea urchin Paracentrotus lividus. 392 individuals had a normal DNA profile and 170 had a mitochondrial DNA profile. TCP, exposed (1 and 10 ng/mL), were maintained in controlled conditions and analyzed at 7 and 28 days. TCP 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 TCP in females exposed to the compound, thus the compound could be catalogued as estrogenic for this marine biological model. Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

MO061
Short-term effects of fluoroxene exposure on biomarker and behavioural responses of an estuarine fish
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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 responses to these contaminants 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 fluoroxene 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 fluoroxene for 96h (0.1 - 100 µg/L) and 2) fish were exposed to high fluoroxene concentrations for 1h (1, 5 and 10 µg/L). Acute toxicity was assessed via multiple biomarker responses, namely antioxidant enzymes activity, detoxification enzymes activity, neurotoxicity and biomarkers of deleterious effects (e.g. catalase, glutathione S-transferase, acetylcholinesterase, lipid peroxidation and DNA damage). Behavioral responses were also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoroxene 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
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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 dibeno-p-dioxins and furans (PCDD/Fs), dioxin-like polychlorinated biphenyls (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 (lw) (range: 474-3840 ng/g lw), with males showing statistically higher levels than females (ANOVA, p<0.001). The most abundant DL PCB congener was PCB77, suggesting a higher contribution of higher chlorinated congeners and a higher contribution of lower chlorinated congeners. Total calculated TEQs ranged from 275 to 987 pg g-1 lw. An indication of potential adverse health effects. The sperms of Physeter macrocephalus is a large toothed whale inhabiting the Mediterranean Sea. This endangered species is subject to a number of threats such as exposure to high levels of contaminants. Several studies show high levels of persistent organic pollutants (POPs) in dolphin tissues from the Mediterranean Sea, but data on sperm whales from the same area are much more scarce. In this study, we assessed levels of 12 PCBs, 17 PBDEs and 14 PCDD/Fs in dolphins (Physeter macrocephalus) from 2009 to 2016. Fresh samples were spiked with a suit of PCDD/Fs, PCBs, and PBDEs 13C-labelled standards prior to Soxhlet extraction, and then cleaned-up by using the automated sample preparation system. Samples were analyzed for seventeen PCDD/Fs, twelve DL-PCBs and twenty-seven PBDEs. Quantification was carried out by the isotopic dilution technique by GC-HR-MS on a Trace GC Ultra gas chromatograph coupled to a high-resolution mass spectrometer. Samples’ lipid content was determined gravimetrically. The relative abundance of the study contaminants followed the order DL-PCBs> PBDEs > PCDD/Fs. The mean concentration values obtained were 6420 ng g-1 (2100-20800 ng g-1) for DL-PCBs, 612 ng g-1 (312-1390 ng g-1) for PBDEs and 57.8 pg g-1 (45.8-83.5 pg g-1) 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 for PCDD/Fs which were found in an order of magnitude lower. Yet, they are generally much higher than those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower that those reported for sperm whales from North-Atlantic. The PCDF congener profile (hexa>nona>deca>octa>hepta>hexa) 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>pента>tetra>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-1 lw. and surpassed the threshold of 2 ng g-1 lw. for all compounds in the blubber of striped dolphins, as exposure to high levels of contaminants. Several studies show high levels of POPs in dolphins tissues from the Mediterranean Sea, but data on sperm whales from the same area are much more scarce. In this study, we assessed levels of 12 PCBs, 17 PBDEs and 14 PCDD/Fs in dolphins (Physeter macrocephalus) from 2009 to 2016. 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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 SCPBs, 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 metal levels. Overall, the results indicate that the skin of bottlenose dolphins is altered due to exposure to SCPBs and PBDEs, which co-varied with SCPBs, 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 PCBs, PBDEs, 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
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The present study investigated a battery of stress indices in blood and liver of Eleonora’s falcon (Falco eleonorae Géne, 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 ml⁻¹ min⁻¹ in May and 1.444±0.079 - 9.314±1.618 nmol ml⁻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 measured in the liver of Eleonora’s falcons were in the physiologically relevant range according to baseline levels. The results of the present study showed for the first time that the assessment of a battery of stress indices in tissues of F. eleonorae, together with chemical analysis of data derived from their natural habitats, 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; M.M. Benito, C. Wolf, Tier3 Solutions GmbH

Vertebrate risks 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 risk assessment. We highlight three complementary ways to improve the quality of such assessments. We discuss how to convert acute effect field studies into a ‘deeper’ 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 radio-tracking technique is sensitive enough to monitor the fate of individuals in a treated area over a long period of time, and to find them in the wild. 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 generic radio telemetry studies on real untreated populations of woodland 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. Mos, Texas A&M University / Wildlife and Fisheries Sciences; C. Sandoval, Texas A&M University / 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 brasilianus) 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, PCBs, and PBDEs. Glutathione S-transferases, glutathione peroxidases, and acetylcholinesterase activity were measured to examine possible acute effects due to OC pesticides, PCBs, PBDEs, and Hg. Surprisingly, all the contaminants were present at low concentrations and below those that could be associated with adverse effects; however, altered structure, composition and function, were detected in the livers and kidneys of most samples. A novel coccidian Eimeria sp. was also detected in the kidneys of several cormorants. Our results suggest that aquatic birds using the Trinity River watershed may be affected by legacy contaminants, and these findings 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 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 imidacloprid showed a reduced ability to orient in the field to a northward azimuth. In the current study, we exposed captured birds to acute field trials using 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.

M069 A synthesis of the interactions between anticoagulant rodenticides and wildlife
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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, structure, composition and function, were detected in the livers and kidneys of most samples. A novel coccidian Eimeria sp. was also detected in the kidneys of several cormorants. Our results suggest that aquatic birds using the Trinity River watershed may be affected by legacy contaminants, and these findings should be useful to wildlife managers regarding concerns over contaminant impacts of the Trinity River on wildlife.
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 predatory species exposed to AR-induced mortality 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 suitable to assess risk; and primary AR exposure associated with a substantial area of high 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.

MO707 Environmental determinants of the exposure to anticoagulant rodenticides in non-target species

Anticoagulant rodenticides have some similarities with other bioaccumulative 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 in vivo exposures studies in Japanese quails (Coturnix japonica) and Feral pigeons (Columba livia). Our results indicated that C. japonica was a 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, while 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 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 m.o 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

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Over the last decade, 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 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 developer, boyle weight, reproductive performance. 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.

Field-effect studies as a suitable method to assess effects of plant protection products on free-living common voles (Microtus arvalis): A case study with the fungicide iprodione

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After foliar spray application of a plant protection product on crops, food sources of small mammals may be potentially contaminated with this product. Ingestion of treated food could possibly lead to effects on the population level (e.g. reproductive impairment etc.). In the presented study, it was examined if there were any long-term effects from repeated foliar spray applications of the fungicide iprodione on populations of the common vole, Microtus arvalis. The field-effect study was conducted in Germany during the main reproductive period of the common vole on 14 commercially used grassland fields. Regular life-trapping sessions which followed a capture-mark-recapture design were conducted from June to November 2014 on treated and untreated (control) grassland fields, as well as in adjacent habitats. The design was used as experimental field, both experiment and developer, boyle weight, reproductive performance, and survival rates were determined and analyzed using linear mixed models. Results of the study will be presented in detail in the poster. The results support the fact that field-effect studies, which investigate effects under real use conditions and are included as higher tier refinement option in the EFSA Bird and Mammal Guidance Document (EFSA 2009), are a useful tool for the higher tier risk assessment, even though no internationally agreed standard protocol for mammal field-effect studies is existing yet.

Monitoring NSAIDs in carrion and avian scavengers form Spain: preliminary results indicate that fluoxetine is detectable in the feathers and we will detected in the muscle of another pig (170.5 ng/g). This level of diclofenac was relatively high, but kidney and liver of the same animal were negative for diclofenac presence. An examination of this muscle sample showed a pale area adjacent to a congestive portion that may correspond to the injection point of the diclofenac in the pig. Fluxinix was the only NSAID detected in the studied avian scavengers. Two out of 22 Eurasian griffins (Gyps fulvus) analysed had 330 and 23 ng/g of fluxinix in liver, and two cinereous vultures (Aegypius monachus) 2.83 μg/g of fluxinix in liver, but it was diagnosed as an iatrogenic poisoning at the wildlife rehabilitation center. Lesions in the kidney and visceral gout have not been observed macroscopically or microscopically in 15 Eurasian griffins analysed. Residue levels in carrion and scavengers indicate a limited risk of poisoning, possibly because treated livestock died several hours after NSAID injection. However, veterinary use of NSAIDs can still be a threat for scavengers if veterinarians and farmers ignore the associated risk when treated livestock is used to feed vultures.

Different approaches comparison for evaluation of hypophygal glands from Honeybees (Apis mellifera L.)


Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in natural pollination also in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypophygal glands (HPG) which produce proteinic substance to feed larvae and queen. The aim of this study was to validate the different algorithms (including obtaining the material) to conduct the hypophygal 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 EFSA guidelines (EFSA Journal 2013;117(3):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 (linear and quantitative measurements, imaging); - 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 the whole mount and right HPG. The analysis 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 hypophygal glands development the linear measurement combined with imaging should be used.

Bird and mammal focal species for pesticide risk assessment in rice

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Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through aquatic and other routes of 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 generally 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 species-specific risk assessments for birds and mammals.

MO074

MO075

MO076

MO077

MO078
Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

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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 these reintroduction and one of them is exposure to lead from the ammunition used for hunting. An exposure to lead, even at sub-lethal levels, can be a stressful situation that implies an increase in circulating corticosterone levels. In birds that are rare and difficult to capture, blood sampling for both lead and corticosterone analysis can be a difficult task and with some risk for birds. For this reason, we evaluated the non-invasive approach to study exposure to pollutants and their respective biomarkers is being directed towards the analysis of easy-to-collect samples, such as feathers moulled by birds. The objectives of this study are to quantify the degree of exposure to lead that the bearded vultures have in the Alps by analysing moulted feathers found in the field, relating them to corticosterone levels in the same feather and defining the factors that affect the fluctuations of these two components along transverse segments of feathers. The analysis of the segments of 20 different feathers from different bearded vultures revealed that the abnormal exposure to lead (probably due to the ingestion of ammunition) had a prevalence of 15% (three feathers with levels above 2 ng/g of Pb in rachis), and that the annual incidence of such exposure was 30% (a feather with an abnormal exposure during its development of approximately two months). The concern this study raised in the past about the use of feathers of key scavenging detritus to the concentration of corticosterone, and was significantly influenced by the collection area and the individual (feather). In the present study we observed that exposure to elevated levels of lead can occur in a high percentage of individuals in a population throughout the year, which in the case of the lammergeier of the Alps can entail a risk to the sustainability of the population if this exposure reach lethal levels.

MO079
Post mortem stability of phase I and II biotransformation enzymes in the liver of kelp gull Larus dominicanus


This study evaluated the post mortem stability of phase I and II biotransformation enzymes in the liver of post mortem kelp gull Larus dominicanus for periods up to 24 hours. Liver tissue of two euthanized animals was sectioned into several 1-cm² cubes and stored in individual closed tubes at 25 °C for 0, 1, 2, 3, 6, 12, 18, and 24 h post mortem before liquid nitrogen freezing. Cytosolic and microsomal fractions were obtained from 2.8 to 5.2 hours post mortem. The estimated half-life for EROD varied from 65 to 71 % of initial activity. EROD activity decreased abruptly after the first hour post mortem for both animals. After 3 hours EROD activity presented 65 to 71 % of initial activity and 28 to 59% of its initial activity after 6h, showing an exponential decrease along post mortem period. Our results indicate that time elapsed since death until sample collection plays an essential role for biotransformation enzymes, especially concerning EROD activity. GST seemed to be more resistant to deterioration over time, and it thus appears possible to make valid GST activity measurement in selected post mortem liver tissue of kelp gull. Overall, our findings demonstrate that caution is warranted in monitoring programs when comparing biological samples with different intervals between collection and analysis procedures.

MO080
Investigating thyroid disrupting effects of organohalogenated contaminants in White-tailed eagle nestlings

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The northern white-tailed eagle (Haliaeetus albicilla) is an Accipiter bird, such as the white-tailed eagle, the hen harrier or the golden eagle, which are known to accumulate organohalogenated contaminants (OHCs), due to their apex trophic position. Their endocrine disruption e.g. suppression of baseline corticosterone. The aim of this study was to assess the effect of mercury on this enzyme seems contingent. Due to the low amount of feather samples, Hg could only be analysed in 13 WTE and 8 NG. Mean ± SD were 0.51 ± 0.34 mg/kg in WTE and 0.99 ± 0.47 mg/kg in NG. The analyses of thyroid hormones have been carried out and the results will be presented at the conference with biological parameters and OHCs.

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

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Anthropogenic activities have led to a global increase of Mercury (Hg) in the environment. Due to its high persistence and bioaccumulation, Hg can become a threat to individuals, especially important in nestlings. The aim of the present study was, for the first time, to investigate the effect of POPs and PFAS accumulation in plasma on thyroid hormones (TH) of nestling white-tailed eagles. We also included the body mass and age to assess influence of biological variables on the TH. Blood plasma samples were obtained from 70 nestlings of white-tailed eagles from two archipelagos in Norway, Smøla (n = 35) and Steigen (n = 35), in the summer of 2015 and 2016. In total, 14 polychlorinated biphenyls (PCBs), 7 organochlorinated pesticides (OCPs), 5 polychlorinated diphenyl ethers (PBDEs) and 8 PFASs were quantified in over 50 % of the plasma samples at each location and each year. Our results show higher OHC concentrations in Steigen [median and range; ∑PCBs: 5.1 ng/ml (1.5 – 59.1 ng/ml), ∑OCPs: 4.2 ng/ml (1.3 – 52.2 ng/ml), ∑PBDEs: 0.3 (< 0.1 – 2.6 ng/ml) and ∑PFASs: 20.8 ng/ml (7.2 – 52.9 ng/ml)], then Smøla [median and range; ∑PCBs: 3.9 ng/ml (0.8-34.7 ng/ml), ∑OCPs: 2.4 ng/ml (0.9 – 15.3 ng/ml), ∑PBDEs: 0.2 (0.1 – 1.5 mg/ml) and ∑PFASs: 14 ng/ml (4.6 – 46.7 ng/ml)]. The analyses of thyroid hormones have been carried out and the results will be presented at the conference.
Heavy metals concentrations in Mediterranean Osprey eggs: variations by location, habitat and egg constituent part

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The osprey (Pandion haliaetus) has been historically used world-wide as a sentinel species for the biomonitoring 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. Maternal (M) and paternal (P) communication were analyzed 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 on 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 the first survey at the 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

MO085

Interactive effects of vitamin E and BDE-47 yolk supplementation on morphological and oxidative status of yellow-legged gull embryos

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Oviparous mothers transfer to the eggs components that have both independent and combined effects on offspring phenotype. Functional interactions between egg components, such as antioxidant and pro-oxidant contaminants, are critical in determining the concentration of one component has effects on offspring traits that depend on the concentration of other interacting components. However, the combined effects of variation in different egg components are virtually unknown. Bird eggs contain vitamin E (VE), a major antioxidant, and also a variable amount of maternally-transferred contaminants. Polychlorinated diphenyl ethers (PBDEs) are a family of brominated flame retardants that have been widely used as non-reactive additive compounds diverse commercial products. Many monitoring studies have revealed the presence of PBDEs in the biota, which can induce a plethora of adverse effects at different organisms’ life stages, often mediated by the onset of oxidative stress. Although PBDEs have been found in birds and their eggs, the consequences related to the exposure to these chemicals in early development is inadequate. In addition, no study has considered that the oxidative stress-related toxicity of these compounds may be counteracted by the presence of antioxidant molecules that mothers allocate to their eggs at the time of laying. The independent consequences of variation in the egg concentrations of VE and PBDEs on offspring phenotype, including morphological and oxidative stress effects, are largely unknown, while no study has investigated their combined effects. Thus, we manipulated the concentration of VE and BDE-47, a PBDE congener having a well-known pro-oxidant activity, in the eggs of wild yellow-legged gull (Larus michahellis) by administering a physiological, large (2 standard deviations) dose of VE and 150 ng/yolk of BDE-47 both independently and in combination. We tested for effects on morphological traits (body mass, skeletal growth) and oxidative stress, as changes in total antioxidant capacity, amount of pro-oxidant species, antioxidant enzyme activity, lipid peroxidation, protein carbonylation and DNA fragmentation, in embryos soon before the hatching.

MO084

Metallic element composition of egg contents and eggshells of the Kelp Gull Larus dominicanus

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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 tend to feed at different trophic levels at different distances from the land and they are long-lived. Pollutants that have accumulated in the seabirds can be excreted in various ways from the body, one being deposition into eggs. Sixteen eggs of the Kelp Gull (Larus dominicanus) were analysed using ICP-MS (EPA 3050b method) 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 0.000057 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 = 0.0141) and Ti (p = 0.0013) concentrations showed significant (p < 0.05) positive correlations between egg contents and eggshells. Chromium and Zn in eggshells and egg contents were not significantly correlated. 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.

MO083

Bioaccumulation of metals in bats: non-lethal vs lethal sampling to assess risk

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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 bats were conducted using egg injections in a non-model species, the American kestrel (Falco sparverius) to assess survival, molecular, biochemical, and endocrine, growth and reproductive endpoints. Analyses conducted on tissue samples from hatchings included thyroid related gene expression in the liver, thyroid hormone levels, and thyroid gland histology. Preliminary results will be presented from the molecular to biochemical to cellular level.

MO079

Highly brominated flame retardants are being replaced by alternative flame retardants i...
M0087 Sensitivity of freshwater pearl mussel juveniles (Margaritifera margaritifera) to different environmental and contamination factors

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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 (Bordogne - 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.

M0088 Using population modelling to reduce uncertainty - an example of a herbicide

M. Wang, WSC Scientific GmbH / Dept Efate 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.

M0089 SETAC Wildlife Toxicology Interest Group

J.E. Elliott, Environment Canada / Science Technology Branch

LCIA method developments in a global perspective: Status and outlook (P)

MO090 A tool to integrate consumer and environmental exposure in life cycle impact assessment

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Direct exposure of consumers to chemical ingredients within our daily products is an important pathway that often dominates environmental performance priorities of these consumer products, but has been currently left aside in LCIA toxicity characterization. The aim of the present study is to update and extend the existing framework to consistently incorporate consumer exposure pathways in a way fully compatible with existing LCIA toxicity characterization methods, and to illustrate it via a case study of plasticizer chemicals in building materials. We developed a general a framework and a tool that extends the toxicity assessment to the near-field and consumer exposure assessment and combines it consistently with the USEtox fate and exposure model. The chemical mass per functional unit in the consumer product is multiplied by the product intake fraction (PIF) to yields the total exposure expressed. The PIF represents the fraction of the chemical in products that is taken in by the consumer. It is determined by coupling fate processes in consumer environments (near-field) with existing environmental compartments and processes (far-field), via a consistent and mass balance-based set of transfer fractions. The developed tool already enables to calculate characterization factors for 22 types of building products, 8 types of personal care products, 7 contact food materials and multiple cleaning product-chemical combinations. The case study of DEHP plasticizer in a vinyl flooring shows that starting from a mass of DEHP in products of 82 kg, 0.15 kg will be taken in, mostly by the household users via dust ingestion as a dominant pathway. This leads to intake doses of 0.14 mg/kg bw/day for an adult and 0.5 mg/kg bw/day for a 3 years old child. Performing a full LCA of the vinyl flooring shows that the 16% of DEHP plasticizer in flooring are associated with dominant shares of impact on human health (9%) and on aquatic toxicity (95%), whereas LCIA characterizes it as a dominant contributor to change impacts (59%). This case study illustrates well the importance to account for consumer exposure to chemical in product during their use. Final outcome is a consistent and quantitative framework and directly applicable tool to determine factors based on scientific consensus for assessing life cycle exposure and toxicity impacts of chemicals in LCIA, as an input to the LCIA guidance efforts of the Life Cycle Initiative.

MO091 Towards the integration of an Agent-based Model into LCA framework to assess dynamic indoor air quality

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The construction sector, representing 44% of the total final energy consumption in Europe, is recognized as a major hotspot of resource use and environmental impacts. Thus, strong efforts are made to encourage the design of environmentally friendly buildings. However, the lighttightness of low energy buildings has created particularly confined and polluted indoors. Indoor pollution has been raised as a major public health issue since we spend on average 80% of our time in closed spaces. Designing sustainable buildings with good indoor air quality is even more challenging since this latter is strongly influenced by occupant’s lifestyle and behavior. Life-cycle assessment (LCA) is a relevant methodology to account for impacts from indoor air while avoiding potential burden shifting from the life cycle of energy or materials used. Nevertheless, the current use of LCA faces scientific obstacles such as: (a) the inclusion of the dynamical effects of indoor pollution on human health and (b) the consideration of the behavior of the occupants. In order to address these concerns, a model of autonomous agent has been developed structured around (i) an agent-based model Li-BIM (Live in BIM) which explicitly represents human behavior, (ii) a physical model to capture the building thermal behavior, (iii) the numerical representation of the building (BIM) and (iv) an innovative indoor air quality model Be-BIM (Breathe in BIM). Li-BIM is an operational model which simulates the behavior of the occupants based on an evolved occupational cognitive and social framework. Be-BIM is currently being developed as a dynamic and localized fate model sensitive to users’ behavior and the indoor driving forces. Therefore, Be-BIM will (i) generate the inventory data for dynamic pollutant emissions and (ii) assess the local impacts from air emissions. Expected outcomes of our integrated model include characterization factors for human toxicity due to indoor air which are dynamic and spatially differentiated at the scale of the building. Eventually, our model will allow the comparison of life cycle impacts of different building scenarios with a specific focus on indoor air quality suited for residential dwellings.

MO092 Adding the resource dimension to the WULCA framework on assessing freshwater use in LCA

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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 distant and local influences that alter the resource, and 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

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The methodology aims on supporting results when assessing the human toxicity of corn farming in Wallonia, Belgium. The USEtox method is applied to the farming of one hectare of corn. Local data are used for farming data and GaBi datasets are used for background data. The field emissions due to farming are calculated by the USEtox method. The many exposure pathways being characterized, the definition of 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 distant and local influences that alter the resource, and 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.

MO095

Impact of heavy metals on human toxicity using LCA: a case study for Wallonia

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Impacts of Chemicals
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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 simplified 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 α-profile of chemicals as attributes, for a better characterisation of the chemical 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 profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP,33.55%) or Eco-Indicator99 (EI99)(18.34%).

MO100
Development of USEtox characterisation factors for micropollutants in effluents
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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 chemicals as attributes, for a better characterisation of the chemical 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 profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP,33.55%) or Eco-Indicator99 (EI99)(18.34%).

MO101
Assessment of freshwater ecotoxicity with USEtox
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USEtox is determined as the reference tool for freshwater ecotoxicity impact evaluation in LCA context. By the way, it is recommended by several institutes: by European Commission for PEFOE project, by JRC-IES in ILCDB handbook, by WGL for the sustainable chemistry and pollution assessment by USEPA 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 showed to influence the calculation of CF as they represent, significant fate and exposure adjustments: substance bioavailability (XF) and its presence in the medium (FF).

Hence, the influence of each factor was analysed in more detail and some inconsistencies were noted. For EF, USEtox includes an extrapolation calculation for acute to chronic toxicity (called Acute-to-Chronic Ratio). This extrapolation is not always reliable and will certainly not be applicable for substances with a log Kow<6 where acute toxicity is superior to solubility but chronic toxicity may still occur. Moreover, the value used for the ACR seems inappropriately low and should be different according to the mode of action of the substance. For XF, adsorption starts to reduce XF at low Koc around 5 whereas adsorption of organic substances is generally considered to become highly significant in ecotoxicological studies performed at low concentrations from log Koc of 4. Overall, the XF seems to be overestimated in this model for the majority of substances with a log Kow between 3 and 5. For FF, one of the parameters that most influences its calculation seems to be the biodegradation, which alone can alter the relationship between the EF and the CF by an order of magnitude (between a highly persistent and a highly biodegradable compound). However, the relative influence of biodegradation (and the other FF parameters) on the CF is too limited compared to the EF value. Indeed, the difference between the minimum and maximum biodegradation on CF is approximately 2 orders of magnitude while the EF itself spans at least 8 log units. Thus, because of these inconsistencies, it is crucial to discuss the relevance of each factor with the aim of improving the model providing a more realistic approach.

MO102
Advancing nutrient modelling in eutrophication methods for life cycle impact assessment

MO103
Land Use Change comprehensive framework in LCA for microalgal cultivation systems as emerging production option in the bio-economy
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Europe is nowadays facing serious issues about natural resources depletion. Promoting the sustainable use of chemical and renewable resources to 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 high added value resource for the bio-economy. The development of several LCAs 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 algae-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, 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 photobioreactors; they may be installed in different natural environments, such as fresh water ponds or offshore cultivation 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

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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 water is accounted. After thorough review of the existing state-of-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: i) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterla.org), a midpoint water use indicator representing the relative Available Water Retaining per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint

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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 considers blue water (fresh surface and groundwater) and green water (rainfall on land that does not run off or can not be run off). According to De Castro, L. Arroja, A. Dias (2018) an insurmountable part of the methodologies to consider this impact category, this work presents the current state-of-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: i) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterla.org), a midpoint water use indicator representing the relative Available Water Retaining per area in a watershed.

MO106 Filling the Gap of Overfishing in LCIA: Eco-factors for Global Fish Resources

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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 (FMSY) 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 FMSY 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 for each of the three life cycle assessment (LCA) of meals 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

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According to recent reports, hydropower currently accounts for 16% 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 emissions due to deforestation of biogeochemically critical lands. 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 state a detailed approach of inventories 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 decarbonising the Peruvian electricity grid, other environmental categories, such as eutrophication and depletion and climate change. However, only few of these impact pathways are fully implemented in currently available LCIAs, 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 photobioreactors; they may be installed in different natural environments, such as fresh water ponds or offshore cultivation 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.

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 potentially not occurring fraction of species (PNOF) due to a change in the river basin-specific emission of P or N 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 from wastewater emissions from year 2000 compared to year 1990 were separately modeled for every river basin in the world. Effect factors were based on 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 surveys. Our work provides the opportunity to quantify worldwide spatially-explicit phosphorus and nitrogen 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 LCA, 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. Leclercq, 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-IO model is based on specific monetary and environmental data for the Flemish region of Belgium and is part of an interregional IO-model in which trade with the Brussels and Walloon 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 footprint 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 relationship between economic structural change and CO2 emissions

K. Shironitta, Kyushu University / Eonomics; 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 employed the composite structural decomposition analysis 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 these environmental effects. Specifically, we employed a multi-regional input-output model (MRIO) 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 services 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

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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 Ecoinvent SE includes emissions to air, water and soil in 44 countries and 5 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 dataset 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 (ENEEI) by upscaling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory ENEEI covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we showed that using ENEEI 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. Kamezoto, 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 due to consumption end up. As the LCA database and LCA data machine covers 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 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. Strocka, 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 it 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
MO115 Static and dynamic modeling of high performance buildings: Comparison of average electricity use and electricity mix, a conditional effect on LCA results

M. Bilec, W. Collinge, University of Pittsburgh, PA, USA / Civil and Environmental Engineering; R. Hickenbacker, University of Pittsburgh, PA, USA / Civil & Environmental Engineering; A. Landsis, Clemson University, SC, USA / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine, NY, USA / School of Population and Public Health

Telligent online life cycle assessment (LCA) involves explicit assumptions and major uncertainty 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 building’s electrical energy consumption in relation to the regional electricity grid, making our findings indicative of a regionality scale.

Several studies have assessed life cycle environmental impact of public transport systems and intermediate public transport (IPT) modes viz. taxi, auton Dominic, London, London L. (2021). Modelling and monitoring of pesticides fate and exposure in a regulatory context (P)

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 impacts of different commuting options. The objective of this study was the development of an LCA based framework to evaluate, analyse 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 all stages of the construction process, 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 (PVT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PVT 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. MERCHAN, University of Liege / Chemical Engineering, PEPs; S. Groslandmet, University of Liege / Chemical Engineering; A. Leonard, Liege Universite/ Chemical Engineering - PEPs

BRAIN-TRAiNS 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 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-TRAiNS 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 road-rail routes in Belgium. The aim of this analysis is to compare the environmental impacts of these intermodal routes depending on the freight transport mode chosen (rail or road transport) for the major part of the intermodal route. Finally, we have analysed how the increase of rail freight transport in the modal split as a result of the possible development of the intermodal rail freight transport affects the environmental impacts of inland freight transport in Belgium. For this, three divergent Belgian scenarios with a time frame set in the year 2030 have been built for further analysis. These scenarios are directly linked to the third strategic goal of the European Commission’s White Paper on transport (2011). As a result, a best, worst and medium case scenarios have been developed, depending on whether the 30% shift will have been successfully accomplished, the status quo will have been maintained or the goal will not have been completely reached by 2030, respectively. The results obtained in this research will lead to a build plan of the modal split and 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. Witt, Bayer AG / Environmental Safety; S. Beulke, Envisearch 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 may not be leading as it does not account for systematic deviations, while the 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 assessed separately by 4 experts based on visual assessment, using scores between 0 (clearly SFO) and 10 (clearly bi-phasic). Individual scores showed high variability, making the subjectivity of visual assessment. Based on group discussions, we derived group consensus scores. Consensus scores showed little correlation with Chi2err (R² < 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 (R² = 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 intermediate data). The residue area contributes to the SWARC weight, 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.
MOI120 "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. Platc, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modeling; B. Erzgrabner, BASF SE; P.F. Donaldson, BASF Corporation / APD/EPR, J. Goelert-Fornt, 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. Several approaches have been identified between the New Zealand and Chilean sites and EU/NAFTA using the OECD ENASGIS tool as well as an adapted GIS crosswalk with JRC-EFSA 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 Northern 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. The sites were chosen in a way that any differences between the sites can be attributed to the environmental conditions. 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.

MOI121 Residues of currently used pesticides in Central Europe arable soils: status quo, transitions 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; J. Biedl, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Brandstätter-Scherr, National University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); P. Dinisová, AQUATEST Inc. ; Z. Simek, L. Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Šádova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Stálka, Masaryk University / Central Institute for Supervising and Testing in Agriculture; M. Svobodová, L. Krkolová, J. Vacíková, 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 in groundwater, it was concluded that banned toxic simazine is still introduced significantly to the soils as an allowed impurity of massively applied terbutylazine. Persistent atrazine residues are still a legacy of the past, even over 10 years after its last use. The second most frequent compounds were conazole fungicides (present in 74% soils; 53% soils with conazole sum exceeding 0.01 mg/kg). Although no health or environmental risk analysis has yet been carried out on the data, the results draw attention to potential impacts, because: (a) foreign limits based on risk calculations have often been exceeded; (b) many of these substances are suspected carcinogens or endocrine disruptors; (c) substances occur in mixtures whose (eco)toxicity may be additive or even synergistic. The research was carried out with the support of the GACR (project 15-2006S).

MOI122 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer?
P.I. Adrianaea, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

The research was carried out with the support of the GACR (project 15-2006S).

MOI123 Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessment
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 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.

MOI124 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 DFOF should also be assessed. Testing of the criterion for met abolite fits should always be included as it was considered that some metabolites can also be useful for metabolitics. 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.

MOI125 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer? P.I. Adrianaea, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

The research was carried out with the support of the GACR (project 15-2006S).

MOI126 Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessment 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 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.

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Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing

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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. Pesticide Chemistry and Management. 172: 172–184.Canceled by the end of 2015

MO125 Spatial and temporal explicit catchment modelling in aquatic risk assessment using the modular framework CMF

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The FOCUS Surface Water assessment for PECsw values was calculated for different crops at different application times with different runoff trigger scenarios. While the drift (SWASH drift calculator) is modelled with similar methods and parameters as in the model MACRO model structure which makes adaption to tiers of different complexity difficult. Flexible and modular approaches are needed to provide a spatially and temporally explicit aquatic exposure pattern to investigate effects on organisms according to Specific Protection Goals. A flexible and modular catchment model for water and pesticide transport has been developed which allows for stepwise adaption of model complexity. The model setup allows for additional parameter studies only using the spatial scale of the assessment. This approach is based on the hydrological programming library CMF. Core functions of CMF are implemented in C++ and specific catchment setups are designed by Python scripting. The current approach focuses on the following abilities in order to investigate landscape-scale interactions: (a) a modular programming structure that enables replacement of process descriptions and (b) an incorporation of detailed information on farming practice and observed discharge as well as 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 adsorption 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 DT50 and Koc. The idea is to find DT50 and Koc values which trigger runoff and drainage scenarios and to distinguish worst-case FOCUS scenarios for different DT50 and Koc values. Dummy substances will be created which have different values for Koc and/or DT50 in soil. The remaining properties will be identical for each Koc/DT50 variation. Using automated FOCUS surface water simulations PECsw values were calculated for different scenarios at different application times with different runoff trigger scenarios. The drift (SWASH drift calculator) as entry paths to focus solely on drainage and runoff. The results for different Koc/DT50 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/DT50 values. Finally, the amount of simulations necessary to show a safe use might be restricted to certain worst-case scenarios depending on the DT50 and Koc properties of the substance.

Quantitative evaluation of passive sampler data for pesticide mass flow calculation in catchments and exposure risk evaluation

T. Galle, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittois, V. Huck, Luxembourg Institute of Science and Technology LIST

Pesticide monitoring remains the blind spot in WFD monitoring schemes because of the episodic occurrence of their emissions following application periods. Full coverage of relevant exposure periods is logistically impossible on a larger scale with classical monitoring methods like grab or automatic sampling. Passive samplers have been proved to provide a cost-effective and time-saving alternative that is particularly useful for drift monitoring allowing thereby a good spatial resolution. However, passive sampling still suffers from a lack of confidence of regulators and investigators with regard to the reliability of the ambient concentrations it represents and the supposed variability of sampling rates in the field. This contribution will show a rational monitoring strategy that has been applied in several catchments in Luxembourg and validated with parallel autosampling of flood events during application periods. It establishes that passive sampling is essentially time proportional and that base- and high flows can be separated for their contribution in terms of time-weighted averages and event mean concentrations. The biases and uncertainties in terms of load calculations are addressed. Based on monitoring in different hydrogeological contexts the approach is used to derive land and crop specific loads in catchments and exceedence probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

MO128 Spatially distributed environmental fate modelling of terbutylazine in a maize agricultural catchment using passive sampler data

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The impact of agricultural practices on water pollution can be assessed by process-based reactive transport modelling using catchment scale models. Most reactive transport models in hydrogeology are based on single substance simulations and calculation and validation. Thus, even if the applied model is spatially distributed, predicted spatial differences of pesticide loss cannot be directly compared to observations. In this study, we applied the spatially distributed reactive transport model Zin-AgriTera in the mesoscale (78 km²) catchment of the Wark River in Luxembourg in order to simulate concentrations of terbutylazine in river water. In contrast to former studies, we used six sampling points, equipped with passive samplers, for pesticide model validation. At each sampling point, event mean concentration of six events from May to July 2011 were calculated by subtraction of baseflow-mass from total collected mass assuming time-proportional uptake by passive samplers. Continuous discharge measurements and high-resolution rainfall data were used during event simulations and the model was calibrated and validated. Detailed information about maize cultivation in the catchment and nation-wide terbutylazine application statistics (average of 341 g/ha in the 3rd week of May) were used for a definition of the pesticide input function of the model. The hydrological model was manually calibrated to fit baseflow and spring/summer events. Substance fluxes were calculated using 100 Monte-Carlo simulations of physicochemical substance properties and processes assessed in the literature: surface soil half-lives of 10–35 d, Freundlich KOC of 150–330 ml/g, Freundlich n of 0.9 – 1 and adsorption/desorption kinetics of 20 – 80 1/d. A multi-criteria Nash-Sutcliffe efficiency including substance loads and concentrations at all stations was calculated resulting in values up to 0.80. The best 100 parameter sets were evaluated for terbutylazine pathways and balances. The model simulated overlaid flow to be the major source (80–95%) of terbutylazine in the main channel and surface water fluxes to be the most important pathways in the tributaries. Simulation results suggest that 0.07–0.14 % of applied terbutylazine mass was exported to the river in the Wark catchment. In addition to calibration of substance characteristics, passive
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 as 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 GAs 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 pesticide residues emitted to surface water bodies are from urban and agricultural sources. At present these sources are risk-assessed using very different scenario-based approaches in isolation. Using a multi-disciplinary approach drawing on landscape implementations of the FOCUSssw scenarios to describe possible agricultural sources and an urban emission model to describe possible hard surface usage, this poster considers the likelihood, magnitude and FOCUSssw toxicity of these different sources of pesticide residues. The need for these two sources to be considered jointly within landscape and catchment scale risk assessments and the possible implications are discussed.

MO133 Calibration of passive samplers for the monitoring of chlordecone in French Caribbean rivers
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The uncertainty of the tropical weather in the French Caribbean makes spot sampling of chlordecone obsolete and new approaches should be explored to better address the fate of this compound in aquatic systems. To this end, two types of passive integral 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 POCSny30µm (with nylon membranes), and the POCSny 0.1µm. Calculated sampling rates (Rs) were corrected by a PRC (Performance Reference Concentration) approach. Laboratory calibration was done under a continuous flow system, and the field calibration was done in triplatzics in river Capteperse (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L/day for the POCIS, 0.09±0.01 L/day for the POCSny 0.1µm and 1.54±1.38 L/day for the POCSny30µm. Two distinct Rs have been calculated for the POCIS and the POCSny 0.1µm: one for the first five days of the experiment (Rs = 0.19±0.01 L/day for POCIS; Rs = 0.48±0.50 L/day for NOCIS 0.1µm), and one for the overall experiment (Rs = 0.19±0.02 L/day for POCIS; Rs = 0.43±0.01 L/day). POCSny 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than...
in the laboratory calibration (Rs=0.82 ± 0.193 L−1). POCIS and POCISsny samplers 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 at these sites were gathered from 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, isoprothiolane, iprobenfos and thifluzamide as fungicides were mainly detected in rice season. While other fungicides including dimethaconazole, propiconazole, fenamiphos, narmilur and bosalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphates, cadusafos, diazinon, fenitrothion, fenitrothion and prothiofos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Surface waters, which were monitored, nine pesticides which include alachlor, butachlor, dimethametryn, dithiophos, ethalfluralin, metolachlor, oxadiazoin, simetryn and thiobencarb 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 insecticides and herbicides 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, hexazinone and tebuconthion), 3 fungicides (azoxystrobins, carbendazim 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/MS/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 mean recovery was 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%), carbendazim (93%), tebuconthion (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, carbendazim, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbendazim (10%), tebuconthion (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuconthion, 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. Peranginangin, Syndenta Crop Protection, LLC / Product Safety; A. Tornisielo, DIQUA / CGASQ; A.V. Waichman, Universidade Federal do Amazonas; K. Son, Y. Ihm, H. Lee, National Institute of Agricultural Sciences / Department of Agro-food Safety & Crop Protection

A tri-partite technical working group consists 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 Herbicidal Source Areas and Spatial Variability of Dominating Transport Processes in a High Agricultural Intensity Catchment H. Rahmani, T. Haering, BASF SE

Pesticides in water and surface sediments from Douro River estuary (Portugal) - assessment of environmentally relevant mixtures using acute toxicity bioassays M. João Rocha, ICBAS / University of Porto; C. Cruzeiro, ICBAS / University of Porto; C. M. Matos, ICBAS / University of Porto; E. Rocha, ICBAS / University of Porto

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
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 Srl; / Department of Earth and Environmental Sciences; C. Pellegrino, Dow AgroSciences Italia srl; R. Bradascio, Dow AgroSciences Italy srl; F. Hegler, DowAgroSciences

In Italy, the presence of myclobutanil and its metabolites in groundwater was investigated using a monitoring programme following its use in pome fruit, stone fruit and vineyards. For national registration in Italy, FOCUS groundwater modelling suggested that the PECgw for myclobutanil and its metabolite in soil is very low. Similarly, the probability of myclobutanil and its metabolites being detected in groundwater exceeded the trigger value of 0.1 µg/L in all cases. A total of 150 samples were analyzed, the concentrations of myclobutanil and its metabolite in soil (X1129885) were below the LOD (0.001-0.0002 µg/L) in 94% of cases, and in groundwater (X1129885), 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 is very low.

MO140 Identification of areas at risk of groundwater leaching in Italy for the fungicid 1,3-dichloropropene

R. Verro, University Milano - Bicocca - Lybra ambiente e territorio Srl / Department of Earth and Environmental Sciences; R. Bradascio, Dow AgroSciences Italia srl / RD; C. Pellegrino, Dow AgroSciences Italia srl; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; 1,3-Dichloropropene (1,3-D), also known as TeloneTM, 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 to 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 were 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 interpolated, and the need for a need for additional data is determined. Finally, by considering 1,3-D use data, it was possible to refine the areas previously identified and quantify the percentage of areas potentially at risk of leaching where TeloneTM 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 modelling approaches for the assessment of groundwater and exposure of soil organisms to a defined range of scenarios. These 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, 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 standardized FOCUS model framework. This was accepted a need to be updated to new data, and that the need to develop a distributed model is that the model can be used for EU28, state member, 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 modelled 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; O. Naeh, SGS Institut Fresenius GmbH; S. Reischauer, DR. KNOELL CONSULT GmbH / Environmental Fate / Modelling / GIS

FOCUS modeling is being used in 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 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. Geuvara, 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 geographical information system, impact modeling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution impact 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/SEAGFW). The main issues when dealing with groundwater monitoring data are: (i) data have 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.eaufrance.fr). This database (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 data 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 risk assessment and 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, Kᵣᵣ and Freundlich coefficient (1/α). Great variations in PECgw values are expected when high variability occurs 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 Kᵣᵣ 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, Kᵣᵣ and 1/α 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 Kᵣᵣ 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 Kᵣᵣ 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 underestimate 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. Gimian, The Danish Environmental Protection Agency / Pesticides and Genetotechnology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cgb; A. Schwen, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tüting, 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 publically 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 use it and (iii) the interpretation of monitoring data 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. Reinenk, 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 that 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 not be overestimated and added rather as average effect (EFSA 2015, 2017). The foliar 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 wash-off factors is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 wash-off factors are slightly above the existing default wash-off factor of 0.5 cm-1. 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 Validation of environmental concentration in soil EFSA 2010: 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. Reinenk, 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. Lamshoefit, 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-labeled 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 processes (e.g., HFCs and HCFCs). The metabolism of this chemical in plants and animals includes, among others, 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 hydroponic 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. Michielsen, H. Stallinga, P. Van Velde, 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. This study involves two different
sampling techniques. At 50 m downwind, airborne spray drift is measured in vertical
movements and local fluctuations in driving speed, wind speed and wind direction are the most
likely factors affecting variance in downwind spray deposits. In this study variations in
downwind deposits of spray drift caused by sprayer boom movements are
investigated both experimentally and based on simulations using the spray drift
model IDEFICS. Downwind deposits of spray drift were measured alongside a
treadmill at a constant speed. Consequently, the part of the spray that is applied
was recorded during the experiments. Horizontal and vertical movements of the sprayer
boom were recorded as well. Variance of spray deposits at 2 m downwind from the
field edge was about 50%. At 5 m downwind variance was about 30%. A
quasi-dynamic model was developed based on the IDEFICS spray drift model. In
the new model the effect of both horizontal and vertical boom movements on
downwind spray deposits was studied. From the above mentioned experiments, the most
important frequencies and amplitudes of boom movements were derived. Using these frequencies, the model simulations resulted in variances of spray drift
deposits similar to those established experimentally. Effects of fluctuating wind
directions are to be investigated in the near future.

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
Project Avenedegroen, J. de Zande, Wageningen University and Research / Agrosystems Research
Investigating the exposure of residents to pesticides due to airborne spray drift in
field conditions and environmental conditions was investigated. Still, there is
a large variance in the observed data that cannot be explained satisfactorily by
the experimental and environmental conditions. This study involves two different
sampling techniques. At 50 m downwind, airborne spray drift is measured in vertical
movements and local fluctuations in driving speed, wind speed and wind direction are the most
likely factors affecting variance in downwind spray deposits. In this study variations in
downwind deposits of spray drift caused by sprayer boom movements are
investigated both experimentally and based on simulations using the spray drift
model IDEFICS. Downwind deposits of spray drift were measured alongside a
treadmill at a constant speed. Consequently, the part of the spray that is applied
was recorded during the experiments. Horizontal and vertical movements of the sprayer
boom were recorded as well. Variance of spray deposits at 2 m downwind from the
field edge was about 50%. At 5 m downwind variance was about 30%. A
quasi-dynamic model was developed based on the IDEFICS spray drift model. In
the new model the effect of both horizontal and vertical boom movements on
downwind spray deposits was studied. From the above mentioned experiments, the most
important frequencies and amplitudes of boom movements were derived. Using these frequencies, the model simulations resulted in variances of spray drift
deposits similar to those established experimentally. Effects of fluctuating wind
directions are to be investigated in the near future.

MO151
Investigating the exposure of residents to pesticides due to airborne spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research;
J. Van de Zande, J. Michielsen, H. Stallinga, P. Van Velde, Wageningen University
and Research / Agrosystems Research
Project Avenedegroen, J. de Zande, Wageningen University and Research / Agrosystems Research
Investigating the exposure of residents to pesticides due to airborne spray drift in
field conditions and environmental conditions was investigated. Still, there is
a large variance in the observed data that cannot be explained satisfactorily by
the experimental and environmental conditions. This study involves two different
sampling techniques. At 50 m downwind, airborne spray drift is measured in vertical
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was recorded during the experiments. Horizontal and vertical movements of the sprayer
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important frequencies and amplitudes of boom movements were derived. Using these frequencies, the model simulations resulted in variances of spray drift
deposits similar to those established experimentally. Effects of fluctuating wind
directions are to be investigated in the near future.

MO152
Risk assessment for consumers of co formulators used in Plant Protection
Products. Case study of polymers.
P. Adrian, M. Liegeois, M. Darriet, B. Jouneau, CEHTRA SAS
A number of papers has recently published guidance on how to conduct a risk assessment
for consumers for co formulators present in plant protection products. One of the
reasons is the lack of exposure data when the product containing its co formulators
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). Simulated spray drift data is used and the use
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 formulant. 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
Xavier Buron, L. Ferreira, EFSA - European Food Safety Authority / Pesticides Unit
Science-based approaches and integrated risk assessments 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 (MRL) are
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 is 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
corresponding data are applied. To this regard, EFSA assesses the residue
behavior in plants and animals, degradation of the compounds in soils and in
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.
dernal exposure of flubeniamide was 3653.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubeniamide (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 20.2 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 flubeniamide for cabbage field would be minimum. Keywords: Flubeniamide, exposure, risk assessment, whole body dosimetry, IOM, cabbage. *Corresponding author: kjh2404@stu.ac.kr; Tel, 82-02-880-4644

MO155 Multi-focus Surface Water Calculations: What do they mean for real regulatory cases? D. Schaefler, Bayer Crop Science / Environmental Safety; G. Reinenk, Bayer AG, Research & Development, Crop Science / Environmental Safety; A. Boledhan, Bayer AG, Research & Development, Crop Science; S. Heine, Bayer AG / Effect modelling; G. Goerlitz, Bayer Crop Science 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 FOCUSww 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 established methods for both FOCUSww and sw 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-focus 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-focus 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. Gottiardi, M. Pasini, Agrea SRL; R. Bondi, Novartis 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 surface water. The modelling framework includes default values relating to the pesticide removal efficiency of such buffers. Recent research suggests that these default removal efficiencies are overestimated for some pesticides. An applied 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 vine 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 amount of runoff was not controlled in order to simulate a situation 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 runon displacement and concentration. Runoff event consisted in 2 phases: 1) Irrigation with sprinkler at 14 mm/h for 50 min (total: 12 mm), to simulate rainfall before runoff; 2) Run-on/Runoff event: 200 mm of water were released into the buffer area in 2:20 hours using a runner generator (flow of 85 mm/h). Water content was pre-determined in a flow of 4 spinosad contained into buffer area, the ‘Run-on’ becomes “Runoff”, and Runoff water was sampled at 0.75, 1.5 and 2.20 hours after Run-on start. During Run-on, irrigation continued until the end of run-on (other 33 mm), and a total of 45 mm were applied to buffer area. Given the frequencies of selected rainfall (low, return period of 2 years), the runoff/rainfall rate (high, 45%), the source to buffer area proportion (high, 10 to 1), and the plot slope (from 10% to 13%), conditions of the experiment can be considered highly precautionary, and more prudent than those of Focus R4. First results show that the runoff displacement ranges from 3 to 11 m from Runoff releasing. Analysis of spinosyns concentration are in progress.

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 (REPRO); A. Friel 2, EFSA - European Food Safety Authority / Pesticides Regulated Products REPRO

*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 definitions. This was revised by the European Commission, EFSA prepared a guidance on the residue definition for dietary risk assessment which intends to complement the OECD guidance. 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 ARID 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 floxuridine. In September 2016, EFSA organised a technical meeting with stakeholders on its new guidance to exchange views. EFSA 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):4594, 129 pp. doi:10.2903/j.efsa.2016.4594. OECD (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. *Info 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 Ecotoxicity Assessments (P)

MO158 Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca C. Scholzheim, 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; J. Bischof, Fraunhofer 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-vivo BCF testing: I) An invertebrate flow-through bioconcentration test system using the freshwater amphipod Hyalella azteca and II) in vitro depletion 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 depletion assays have been successfully applied to improve in-silico predictions for BCF values by adding the highly variable behavior of metabolites to the existing BCF prediction of this model. 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
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 (Percaidae). This study investigated in vitro inhibition of aromatase by the model inhibitor, fadrozole, across eighteen phylogenetically diverse species of freshwater fish. Concentrations of fadrozole that result in 50% inhibition of in vitro aromatase activity (IC50) are compared from 1.04 x 10^-8 M among these 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, propiconazole, and fadrozole 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 adverse outcome pathway (qAOP) for aromatase and combined with the RAMOS biotechnological animal model for investigating the toxicological effects of environmental contaminants. Preliminary results suggest that aromatase inhibition among the species used in this study could serve as a mechanism-based biomarker of exposure to alkylated aromatase inhibitors.

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 various toxicological purposes because it accounts, in principle, for the environmental exposure of organisms consuming the contaminated food chain. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO161 Assessing differences in sea turtle organ sensitivity using cell-based toxicity assessment
K. Finlayson, Griffith University - Smart Water Research Centre / Australian Rivers Institute; F.D. Leusch, J. van de Meere, Griffith University / Australian Rivers Institute
The long-lived nature of sea turtles and their lengthy residence in coastal foraging grounds can result in high exposure to contaminants from urban, industrial and agricultural sources. Organic or inorganic contaminants have been quantified in all species of sea turtles worldwide. However, very little is known about how these contaminants impact turtle health, valuable information for identifying populations at risk. In vitro exposure experiments using cell cultures established from turtle tissue provide an ethical, reproducible and cost-effective method to identify threats of environmentally relevant contaminants to sea turtles. In recent years, the majority of sea turtle cell lines have been established from skin samples. However, as ingestion is the main route of exposure for these animals, cell cultures established from organ tissues may be more pertinent. This study used a number of primary cell cultures established from the skin, ovary, heart, liver and small intestine from three individual green turtles to investigate the variation in sensitivity between organ types. Cytotoxicity of five organics and five inorganic compounds was investigated using an in vitro cell viability (MTT) assay. Differences in sensitivity were also investigated based on their order of sensitivity to all compounds tested. The results were then used to assess risks to sea turtle populations worldwide. The results provide recommendations for further toxicological studies involving turtle cell lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

MO162 Comparison of rat liver S9 to an animal-free alternative ewo59R in the Ames fluctuation assay
J. Brendt, RWTH Aachen University; B. Thalmann, EWOMIS; K. Blum, University of Saskatchewan; K. Kaufmann, RWTH Aachen University / Department of Biochemical Engineering; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; A. Schwä, EWOMIS; J. Büchs, RWTH Aachen University / Department of Food Science and Nutrition; P. H. Hollett, RWTH Aachen University / Institute for Environmental Research
The Ames test is the most important in vitro test for mutagenicity performed in many variants. The original agar-plate assay was modified to reduce the amount of assay components like rat liver S9 and the length of time needed for test preparation and evaluation. The Ames fluctuation test was established as a less time and manpower intensive method and was used for the assessment of environmental contaminants. Cytotoxicity of five organics and five inorganics were investigated in vitro tests to identify threats of environmental contaminants to the bacterial culture. Furthermore, it can be implemented as an online-monitoring system on mutagenity in applications like drinking water monitoring. However, as the Ames test is conducted with a microorganism, it lacks the metabolic activation of a mammalian metabolism. Hence, the mutagenicity of promutagens would be underestimated. Therefore, the bioassay is supplemented with an animal-derived product the rat liver S9. In animal experiments rats are treated with toxic substances via percutaneous or intravenous injections or feeding. Subsequently, the animals are euthanized to obtain the liver, which is homogenized, centrifuged and frozen. The commonly used rat liver S9 is a necessary component in various in vitro tests to increase the information about potential mutagenic substances. However, this product varies in its enzyme consistency and purity from batch to batch. Therefore, in the context of 3R to reduce animal experiments and to obtain more reliable in vitro assay components alternative should be introduced. In the present study, we investigate the applicability of a substitution of rat liver S9 with the biotechnological animal-free ewo59R in the Ames fluctuation assay and the Ames-RAMOS system. Therefore, we investigate 26 promutagens with both metabolic systems. Preliminary results suggest that ewo59R is a suitable alternative to rat liver S9.

MO163 QSAR: a predictive approach for electronic cigarettes toxicological assessment
D. Zarini, University of Isfahan; E. Papa, A. Sangion, University of Isfahan / SETAC Europe 28th Annual Meeting Abstract Book
MO164

Evaluation of QSAR models for daphnia and fish chronic toxicities of human pharmaceuticals

T. Yamada, National Institute of Health Sciences; M. Kuriimoto, 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. Tatarazako, Ehime University / Chemistry, Biochemistry and Health Research Laboratories; 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 stages. As a tool for predicting toxicity in daphnia and fish, two QSAR programs with R² values ranging from 0.7 to 0.9 and Q² values ranging from 0.7 to 0.8. These models were used to perform a screening of the acute toxicological profile of the 265 molecules of interest and to compile a priority list of substances of potential toxicological concern. This preliminary study represents a first step toward the hazard assessment of e-liquids and for the identification of safer alternatives to existing and potentially harmful ingredients scored from the chemical structure. However, additional work still needs to be done to make these products safe for human use.

MO165

Optimization and Accessibility of the Eco-Database and the Ecotoxicological Threshold of Concern (ecoTTC) tool


The Ecological Threshold for Toxicological Concern, or ecoTTC, has been proposed as a natural next step to the well-known human safety TTC concept. The ecoTTC is particularly suited for use as an early screening tool in the risk assessment process, in situations where chemical hazard data is poor, or when an appropriate QSAR is unavailable. ecoTTCs are developed using statistical distributions of Predicted No-Observed Effect Concentrations (PNECs) to reflect the breadth and depth of the ecotoxicological dataset beneath, and therefore, the ecological and quality of the underlying dataset is crucial to the future utility of the ecoTTC. An eco-database consisting of approximately 110,000 unique ecotoxicological records, 6200 unique CAS numbers and 1900 species from three trophic groups has been created based on recent assessments of published data and screening of metabolic and associated product amine 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 / Environmental Safety

According to 2011 figures, 80% of the animals used for testing procedures in the European Unionic rodents and almost 23% 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 (3R’s) 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 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 curve. These predictions can then be compared to corresponding in vivo data. The predictions 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. Akam, Lee University of Seoul; H. Byun, University of Seoul / School of Environmental Engineering; N. Chatterjee, University of Seoul / Environment Engineering; J. Choi, University of Seoul / School of Environmental Engineering

Metabolic and neurodevelopmental disease have been attracting attention as
MO170 Chemoavailability of Organic Electrophiles - A Nonanimal Approach to Identify Candidates for Reactive Toxicity

A. Bohling, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry, G. Schuettengruber, Helmholtz Centre for Environmental Research - UFZ / Department of Ecological Chemistry


MO171 Local Electrophilicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward Tetrahymena pyriformis

D. Schuhmacher, D. Wondrousch, G. Schuettengruber, Helmholtz Centre for Environmental Research / Ecological Chemistry, D. Wondrousch - UFZ / Department of Ecological Chemistry

Electrophilic compounds such as α,β-unsaturated carbonyls are valuable reactants 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 and DNA, resulting in reactivity driven excess toxicity. Therefore, 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 quantum chemical descriptors. The contribution of the electrophilic reactivity 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 compound 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. Bicherval, 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. Using tools such as weight-of-evidence, data from in silico, in vitro and in vivo assays have been developed to support a weight of evidence approach to assess bioaccumulation potential in fish. A draft guideline entitled, Determination of in vitro intrinsic clearance using cryopreserved hepatocytes (RT-HEP) or liver S9 sub-cellular fractions (RT-S9) from rainbow trout and extrapolation to in vivo intrinsic clearance is currently undergoing OECD review. The procedures as outlined in this draft guideline were used to determine measured in vitro intrinsic clearance rates. These rates were then used to predict fish BCF values for several active pharmaceutical ingredients for which in vivo clearance and fish BCF values have been determined as per the OECD 305 Guideline. The outcome of these in vivo assays will be presented along with the in vivo BCF data.
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 therefore hydrolytic activity of esters in algae negligible. The dialkyl-esters appear 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 unsaturated, 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.

**MO173 Nanosecond 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. Safety Health Environment; A. Tanaka, Prefectural University of Kumamoto / Faculty of Env. Safety Health Environment; K. 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 nanosecond 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 nsPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

**MO174 Moving 3D in vitro intestinal models forward: transcriptomic characterization of the RTgutGC cell line**

L.M. Lanean, 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 investigations into specific disease mechanisms. A major challenge is the development of 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 toxicology tool. Cell lines are known to acquire additional mutations or modifications while in culture, and it is important to understand to what extent this cell line retains the genetic landscape of primary intestinal tissue. In this study, RNA-Seq sequencing of the RTgutGC cell line was used to establish gene expression in this potential animal replacement model. Over 84% of the sequences were mapped to the rainbow trout genome. Following filtering for transcript abundance using TPM (transcripts per million), 24,890 contigs were identified and blasted against the NR database. InterProScan was run in parallel to blast annotation and later merged with annotation to confirm. Over 43 genes were shown to be differentially expressed in the cell line compared to the native tissue while 229 were shown to be down regulated. KEGG pathway analysis revealed the presence of significant metabolism pathways still active in the model. This study provides the first in-depth sequencing data of any rainbow trout cell line and identifies many commonalities between the 3D model and native tissue. Characterization of the RTgutGC transcriptome and genes and enzymes expressed in this model will greatly help in building realistic in silico models of exposure when integrated with other available chemical data.

**MO175 Impact of test concentration on the in vitro intrinsic clearance using trout liver S9 fractions to predict the bioaccumulation potential of fragrance chemicals**

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Bioaccumulation in aquatic species is a critical endpoint in the regulatory assessment of chemicals. The bioconcentration factor (BCF) is usually determined in fish (OECD TG 305). In vitro systems measuring biotransformation rates of chemicals to refine BCF model estimates have been established as alternative methods to refine predictive models which are based on hydrophobicity (i.e. log Kow). Fragrance chemicals frequently contain different isomers complicating its analysis especially at low concentrations. Thus, they have been commonly tested at 1 µM. Results reported recently indicate that first order depletion rate constants (kdep) measured at test concentrations of 1 µM could underestimate the in vitro intrinsic clearance resulting in overestimation of the BCFs. However, these observations were mainly reported for substances from one chemical class (polyaromatic hydrocarbons, PAHs). For pyrene, chrysene and benzo(a)pyrene, kdep determined at lower concentrations were 4- to 12-fold higher than kdep measured at 1 µM. However, the effect of test concentration of industrial chemicals is lacking. The goal of this study was to compare kdep values using different concentrations (e.g. 0.2, 1, and 5 µM) for four fragrance chemicals. These chemicals represent a diverse class of high log Kow (4.3-6.5) industrial chemicals. Rainbow trout liver S9 fractions from different sources were used and their enzymatic activity characterized using commonly used fluorescence assays (EROD, p-nitrophenol glucuronidation and CDNB-glutathione conjugation) and substrate depletion assays with testosterone, 7-hydroxycoumarin, pyrene and Cyclohexyl salicylate as reference chemicals. Decrease of the present concentrations was analysed by GC-MS or LC-MS and kdep values determined. For the lowest concentration (0.2 µM) ca. 2-fold higher kdep values were observed for Polysantol, Ambrofix, Cyclohexyl salicylate and Karanol compared to kdep values determined with 1 µM. Measured kdep values were 2-fold lower with 5 µM except for a 4-fold lower rate for Polysantol compared to 1 µM test concentration. The biotransformation rates of the fragrance chemicals tested to metal attenuation to LC-MS and kdep (0.2-5 µM) compared to PAHs indicating that their Kow may be substantially higher. Thus, for fragrance chemicals which are moderately to rapidly biotransformed, the use of 1 µM as start concentration seems to be a suitable approach to estimate the bioaccumulation potential.

**MO176 Biological effects of 3 metals on "D" larvae of japanese oystercrassostrea gigas**

A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; C. Cáceres-Martínez, Universidad Autónoma de Baja California Sur

The Crassostrea gigas 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 a 1:1 mixture of metal and their concentrations of metal was 0.2 µM. The Kruskal-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 effect was Chromium (32 ± 8.97 nM Tbars mg⁻¹), while the metal mixture: Cd + Cr + Pb (45 ± 11.89 nM Tbars 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.

**MO177 Toxicity effects caused by exposure to Dichlorvos in organisms of different trophic levels**

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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 Simocephalus polyphemus. The ostracod Cypris sp. and fishes: juvenile Chlorella foraminata (Chlorella foraminata) and juvenile zebrafish (Danio rerio). In addition their sublethal effects were evaluated by means of assessment of four biomarkers (growth rate, O:N index, liperoxidation 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 group. 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 ACh activity was observed in the range 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 laboratories
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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 fractions (Fractions) 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 (phenolics such as chlorinatedphenols and hydroxylated metabolites of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was used together with the established method for primary hepatocytes from rainbow trout to investigate cytoxic 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 F3 fraction, a significant higher induction was observed in rainbow trout hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytoxic effects than rainbow trout hepatocytes. F3 and F2 from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F3 having largest effect. Chemical analysis was preferred to identify potential contributors to the observed effects. The project was funded by the Norwegian Research Council, project. No. 221373.

MO179 Ultrasound: A novel approach to non-lethally measure hepatosomatic index in sentinel fish for environmental monitoring programs
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Canada`s environmental effects monitoring (EEM) program studies impacts of metal mining and pulp mill effluents on aquatic receiving environments. The EEM program for Arctic charr (Salvelinus namaycush) at ISID-experimental lakes area. Our laboratory studies provide evidence for the ease and potential application of this technique for future environmental monitoring programs. Our ongoing method refinement and exploration of this technique in sentinel fish with diffuse livers across different size ranges will strengthen our goal of proposing ultrasound as a viable non-lethal alternative to measure HSI on a global scale.

MO180 Weight of evidence for fish acute toxicity: a Bayesian network modelling approach
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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 ecotoxicology research. A major advantage of the proposed BN model is to integrate information from large and varied ecotoxicological and physico-chemical datasets, and apply it in a WoE approach to predict fish acute toxicity of chemicals from data on fish embryo toxicity testing in combination with other relevant information. The planned steps of the model development and application are: (1) Identification of suitable chemical properties and endpoints as nodes for the BN. (2) Compilation of data on ecotoxicity data for fish embryos and other relevant information. (3) Construction of a BN model for integrating the data and other information in a probabilistic framework. (4) Evaluation of the WoE approach using ecotoxicity data for fish embryos in combination with data on (juvenile) fish acute toxicity. (5) Application of the BN model to assess the risk of various contaminants based on chemicals registered in the European Chemicals Agency database (http://echa.europa.eu).

MO181 Divergent immunomodulatory effects of cadmium between two marine immune immune cell models in vitro, macrophages and mast cells.
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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 might have different impacts upon physiological and pathological mechanisms. Such effects have been observed using the two main types of inflammatory responses, type 1 and type 2. Type 1 cell-mediated immunity is involved in the defense against intracellular bacteria and infected cells, carried out especially by phagocytes like macrophages. In contrast, mast cells are associated with type 2 or humoral/antibodies-mediated immunity, concerned with extracellular pathogens and parasitic infections. In order to study the immunomodulatory effects of cadmium on macrophages and mast cells we carried out a mechanistic in vitro study. Exposure to cadmium depleted glutathione in the four cell lines tested, potentially modulating functional parameters in macrophages mainly as a result of activation of redox-sensitive pathways leading to pro-inflammatory effects. Mast cell showed steeper GSH-depletion, compared to macrophages, prior to the onset of cytotoxicity, indicating increased ROS levels, resulting in potentially increased oxidative stress. A dose-response inhibition in the secretion of histamine was shown, suggesting that mast cell function could be impaired by cadmium. In this way, cadmium may modulate the function of the innate immune system, in such a way, that favours to a type 1 response by enhancing macrophages responses and at the same time affecting the functioning of mast cells.

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. Chaussy, 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
MO183 Baseline vs. Reactive Toxicity toward the Nematode C. elegans as Alternative Bioassay
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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 for assessing the environmental toxicity associated with sediments. The authors confirm that the eco- toxicological and metabolic changes that occur upon exposure to environmental pollutants. Overall, the authors find that C. elegans is a suitable model for addressing environmental issues related to sediments and other anthropogenic substances.

MO184 Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Nonanalional Tool for Mimicking Phase I Metabolism
J. Moldrickx, Helmholtz centre for environmental research - UFZ / Ecological chemistry; A. Böhm, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; A. Becker, Leipzig University; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
The oxidative activation of pro-electrophiles results from the interaction with environmental pollutants. This interaction can lead to the formation of reactive oxygen species (ROS) that can cause oxidative stress and damage to the living organism. In this study, the authors investigated the oxidative activation of pro-electrophiles mediated by an Fe-loaded zeolite. The authors found that the Fe-loaded zeolite is capable of activating pro-electrophiles and generating ROS, which can cause oxidative stress.

MO185 Integrated assessment of aquatic ecotoxicity for regulatory purposes
M. Bagherzadeh, University of Duisburg-Essen; J. Moldrickx
The Integrated Assessment of Aquatic Ecotoxicity (IAA) is a method used to assess the ecotoxicity of chemicals in aquatic environments. This study presents a novel approach to the IAA method, which integrates multiple endpoints and exposure scenarios to provide a comprehensive evaluation of the ecotoxicity of chemicals. The authors found that the new approach provides a more comprehensive assessment of the ecotoxicity of chemicals and is more sensitive to the effects of exposure.

MO186 An integrated testing strategy to fill data gaps for environmental risk assessment of soil-alkalis
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Environmental risk assessment is a critical step in evaluating the potential impacts of chemicals on human health and the environment. This study presents an integrated testing strategy to fill data gaps in environmental risk assessment of soil-alkalis. The authors developed a multi-endpoint, multi-species approach that integrates in vivo and in vitro tests to provide a comprehensive assessment of the potential effects of soil-alkalis on environmental receptors.

MO187 Baseline for the development of biomarkers of chemical exposure and effect in threatened wildlife
J. Moldrickx
The development of biomarkers of chemical exposure and effect in threatened wildlife is a critical step in understanding the ecotoxicity of chemicals and protecting endangered species. This study presents a baseline for the development of biomarkers of chemical exposure and effect in threatened wildlife. The authors found that the development of biomarkers requires a multidisciplinary approach that integrates toxicology, environmental chemistry, and molecular biology. The baseline established in this study provides a framework for the development of biomarkers and the assessment of chemical exposure and effect in threatened wildlife.
Aquatic toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoctanol and isoudecanol. 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 isooctanol concentrations. The derived model is a powerful tool to predict aquatic toxicity of isooctanol, isoudecanol and their derivatives. Additionally, the model is also a useful tool for assessing the accuracy of existing aquatic toxicity data, which may be useful for regulatory agencies.

MO187
Looking for an alternative to glyphosate-based herbicides
V. Lioussa, K. Eisner, S. Limbeck, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Glyphosate-based herbicides are widely used in agriculture. When these products are无所谓地introduced into the market, they are 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 biologically derived substance considered as an environmentally friendly herbicide. Its toxicity level 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-derived 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 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
Chemooassay Profiling of Salicylates to Assess their Reactive Toxicity
A. Wener, Leipzig University; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; G. Schurrmann, 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 exposome. Moreover, hospital waste streams may include salicylates as they may act as constituents of the exosomewaters for flora and fauna. As organic electrophiles, salicylates are able to bind to nucleophilic sites of proteins, peptides or the DNA, thus triggering the reactive moles.

MO190
The Xenopus Embryonic Thyroid Signalling Assay (XETA) for assessment of effluents contamination in thyroid active molecules.
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The Xenopus Embryonic Thyroid Signalling Assay (XETA) was designed as a simple and a low-cost way to provide information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. The XETA 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. XETA 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 XETA 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 wastewater and industrial effluents. A part of our studies focussed on performances of wastewater treatment plant (WWT). Assessing the quality of the WWTs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defines by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect present 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 are associated to changes in temperature. 2) Addition of deionized water to parameterize critical partition coefficients such as C1000 for 15 anionic surfactants, using an optimized solid supported liquid membrane (SLLM) assay. For the anionic surfactant SDS, a logKow of 4.6 was determined, a factor of 1000 higher than the highest reported logP in the REACH dossier, and 5,000,000 times higher than the recommended logP. Our aim is to further optimize the assay to allow comparison between different test substances and thereby to provide a range from C1000 (calculated, and recommended) to 1.6 (experimental, but considered erroneous), ranging more than a factor of 300. Various techniques to develop surfactant or surfactants are described in these REACH dossiers, with conflicting argumentations on which is most relevant. It is well known that Kow is a problematic parameter for surfactants, but this means that to reduce animal testing for bioconcentration factors and (baseline) toxicity of surfactants, insight in the key parameters of pure surfactant components driving uptake in biota is highly needed, alongside better understanding of elimination rate processes for such compounds. The BIONIC model could apply such key parameters for ionogenic surfactants. The phospholipid-water partition coefficient is considered to be the dominant contributor to the overall tissue-water partition coefficient for ionogenic surfactants, because membranes lipids allow for both ionic interactions at the zwitterionic head groups and hydrophobic interactions at the membrane core. Sorption experiments verify orders of magnitude higher affinities of ionogenic surfactants than for ionic lipids. It is known that XETA on WWTP effluents contamination in thyroid active molecules (MA 23 - Project 15-06) is gratefully acknowledged.

MO191
Advances on locomotion detection of Daphnia magna, Artemia franciscana and Parameca caudatum
F. E. 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 PLACEHOLDER 184 SETAC Europe 28th Annual Meeting Abstract Book
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 monitoring for swimming behavior could be a valuable indicator for a wide range of environmental contaminants. 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 Peranemaem caudatum. In order to so, custom-made, portable multwell plates were designed. Therefore, the ease 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 25 - Project 15-06) is gratefully acknowledged.

MO192 Validation of the in silico prediction tool for toxicity of Algae by pharmaceuticals in environment

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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 of 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 prediction accuracy for ecotoxicity prediction by the ECOSAR software, which is based on a compaction 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 ChV for the chronic toxicity were compared with the prediction values estimated by the ECOSAR. The percentages of the pharmaceuticals which of 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 Algae toxicity. Most of chemicals with aliphatic amines had tendency to be underestimated. This difference may reflect on 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 Species


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 develop a set of ‘key target’ 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 cell signaling and transcription factors demonstrating 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 US 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

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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 residues for 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 in the role of specific amino acid substitutions at key positions of proteins and how 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 enabled automatically generated species-specific predictions of chemical susceptibility. These predictions were shown 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 extrapolation of 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. As a research and organ related to human biology, the zebrafish offers the advantage of having a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of end points, 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, 20 zebrafish embryos were exposed to 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, 49/91 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'-hexafluorisopropylidenepheno, 3-iodo-2-propynyl N-butylcarbamate, diethlythlibestrol, hexachlorophene, methylmercury chloride, rotenone and tetraethylthiram disulfide.

MO196

MPA - an alternative for the standard procedure of Ames Test
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The Salmonella/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 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 reversion frequencies (low, mean and high). The miniaturization procedure conditions were made as similar as possible to the Microsuspension 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. Lillcrap, 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
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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 on the platform and then directly discharged into the sea. Despite the low content of toxic compounds that remain in PW after treatment, the large volume of PW lead to high total amounts of toxic compounds discharged every year in to the sea; thus an effective tool for monitoring the hydrophobic organic compounds (HpOCs) is necessary. Passive sampler devices (PSDs) are the most common tools for monitoring a wide range of organic contaminants in water. By this regard, several PSDs have been used to monitor hydrophobic organic compounds (HOCs) in PW including semipermeable membrane devices (SPMDs). However, SPMDs are not suitable for monitoring HpOCs in PW owing to the nature of these chemicals. It is therefore necessary to develop and standardize a passive sampler for HpOCs, such as APs. Polar organic chemicals (POCs) in PW including semipermeable membrane devices (SPMDs) is the most extensively used method for monitoring a wide range of HpOCs. It allows the time weighted average (TWA) concentration to be measured and thus assess fluctuation in discharge concentrations. POCIS is composed of a sorbent (OASIS beads), two polyethersulfone (PES) membranes and two stainless steel rings. POCIS is calibrated by evaluating the sampling rate (R_s), which is correlated with the contaminant concentration in the water and in the sampler, and is usually assessed by extracting the OASIS beads alone. We evaluated the effect of the PES membranes on AP uptake and, for the first time, calculated the R_s, following the extraction of both the sorbent and the PES membranes. This study was a first phase in uptake for APs, and that APs with log Kow>5 were accumulated more efficiently in the PES membranes. The extraction of both the PES membranes and the OASIS beads is thus needed when working with the POCIS in order to capture low contaminant concentrations and allow the detection of the less hydrophobic APs. This can be very useful in environmental applications because it may justify the use of only one passive sampler to monitor a wider range of contaminants.

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
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Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments contaminated by polar organic contaminants (HOC). 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 (C_mw). The C_mw 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 HOCs and are accounted for in laboratory methods (ex situ PS method) providing promising results to measure C_mw in the pore water of sediments, there is still 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 soil samples (replicates) and field soils. The PAHs were located in peat bogs and hence permanently water-saturated, while the other three were located in grassland and thus not saturated. Low density polyethene (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 soils 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
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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 spiking and dwelling of earthworms) model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. The objective of this study was 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 soils 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.
non-sterile and sterile soils. Sterilization appeared to increase uptake rates and reduce the influence of pp -DDDE-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

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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 dissipation and bioavailability in the soil and earthworms was compared using two methods: 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 and laboratory conditions, and the very high heterogeneity in the field experiment. 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

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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 potential for movement of pesticides and their metabolites to ground water and require data derived from experimental studies based on validated guidelines. Currently, guidelines detailing degradation and absorption processes of pesticides and their metabolites in soil do not accurately account for uptake by plants via root system, with plant uptake compartments only being given a default value. As plant uptake affects the environmental availability of these substances, accurately quantifying this process is essential to predict their environmental behavior. This study aimed at determining the uptake of active substances as well as metabolites via plant roots. The purpose of the present study was to obtain reliable substance-specific plant uptake data—with different root zone exposure concentrations—as well as plant uptake parameters (PUF and TSCF) to predict their bioaccumulation potential. The pesticide studied is a specific-triazole with different concentrations in wheat. Recent work by the ECPA/IVA Working Group “Plant Uptake Factor” has produced a draft working paper designed to experimentally determine the uptake of active substances as well as metabolites via plant roots. The purpose of the present study was to obtain reliable substance-specific plant uptake data—with different root zone exposure concentrations—as well as plant uptake parameters (PUF and TSCF) to predict their bioaccumulation potential. The pesticide studied is a specific-triazole with different concentrations in wheat.

MO203 LFER Models for Partition Coefficients of Environmental Concern

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Traditionally, partition coefficients of environmental concern, including 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 uptake or 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, known as Abraham models, are preferred for such predictions. Traditionally, partition coefficients of neutral organic compounds between water and immobilised artificial membranes (IAM), liposomes (membrane lipids), 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 bioavailability 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

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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 particle size distribution on the 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 mean particle sizes were 9.1, 9.6, 13.7, 14.7%, 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 increasing particle size, which supported the hypothesis that HOCs bioaccumulation potential is higher in coarse 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)

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Hydrophobic organic compounds (HOCs) tend to be associated with suspended particles in surface aquatic systems, however, the bioavailability of HOCs on suspended particles to fish is not well understood. In this study, a passive dosing device was used to control the freely dissolved concentration of polycyclic aromatic hydrocarbons (PAHs) including fluoranthene and pyrene, and the influence of particle-associated PAHs on their bioaccumulation by zebrafish was investigated. Results showed that the body burden of PAHs in the zebrafish including the digestive tract (without the head part) were higher than that in the zebrafish excluding digestive tract at the beginning of PAH bioaccumulation, and lower after two day bioaccumulation. The difference may be caused by the effect of PAHs associated with particles in the digestive tract. When PAHs on suspended particles were ingested and they were mainly stored in the digestive tract of zebrafish in the beginning of the bioaccumulation; because the bioaccumulation factors of PAHs in zebrafish were higher than the partition coefficients of PAHs in suspended particles, the concentrations of PAHs in zebrafish excluding digestive tract were higher than that in zebrafish including digestive tract in the later bioaccumulation.
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 Agronomic Bioavailability Testing**

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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 shore-based targets 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 skeet targets 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 skeet fragments reduces the oral bioavailability of PAHs compared to that seen in animal studies using pure benzo(a)pyrene in solvents added to diets. To test this hypothesis, soil samples were collected from the two sites to provide a range of PAH concentrations. Female B6C3Fi mice were fed diets amended with soil or 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 those 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 metabolism rates versus daily dosing rates. The FUEs produced coefficients of determination (r²) 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 would be compared to the RBAF resulting from the regression approach, and the regulatory precedent for the regression approach will be presented.

**MO207 Accurate determination of adsorption coefficients for low adsorbing compounds - from experiment to result evaluation**

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The determination of adsorption coefficients is a critical key parameter for the assessment of the leaching properties of low adsorbing compound’s 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 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* (msoil/msolution); note: msoln/solution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFCFA, 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 Kfoc from isotherms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating opportunities of this approach.

**MO208 Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomomas sp. strain ADP**

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Atrazine is an herbicide used to control grassy and broadleaf weeds in sugarcane, wheat, conifers, sorghum and 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 elicit a negative tactic response at low concentrations. We also observed that the swimming patterns of Pseudomonas sp. strain ADP was followed of 28-39 days. The data was non-parametric, and it was analyzing using Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to be 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.

**MO209 The influence of biochar on the toxic effects of imidacloprid to the lifecycle parameters of Eisenia fetida**

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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 contaminants. 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 analyzing using Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to be 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 Chlorodene elimination kinetics in ewes**

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Chlordene (CLD) is an organochlorine pesticide used from 1972 to 1993 against wheat, conifers, sorghum and corn pests. It is usually consumed in the French West Indies. The objective of this study was to characterize the CLD elimination in ewes (linearity of distribution, metabolism, excretion forms and excretion rates). Three groups of 5 ewes received an intravenous single dose of CLD (0.04, 0.2 or 1mg/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 CART (Belgium) and CLD and its metabolites were analyzed in urines and feces (for the 1mg/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 CLD-DOH were quantified. By comparing the two way of CLD excretion, feces appears to be the principal route of CLD elimination. Almost 60% of the administrated 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 routes of CLD excretion in ruminants 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 chlordecone and its metabolites by HPLC-MS/MS in urine and feces of ewes

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Chlordecone (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, although some contamination is 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 chlordecone (CLDCl) in humans and in pigs and gerbils liver. Then CLD and CLD-DOH can be conjugated by the glucurononitransferase. In feces, CLD-DOH 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 1990 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 a more sensitive method, a new development was carried out with this work. The extraction was carried out with 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, CLD and conjugated CLD-DOH were quantified in ewe feces. In urines, CLD and conjugated CLD-DOH 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??

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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 concentration and their bioavailability. The chemical concentrations of SOC 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 researchers, steps 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 València / Environmental and Food Safety Research Group; F. Calatalyud, E. Simó, Agrupación de Defensa Sanitaria Apícola (apiADS); 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 varroasis by beekeepers are accumulated in wax, pollen and honey bees. Samples of honey bees (45), wax (43) 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 bee hive against varroa mite. Wax and pollen were the most contaminated 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 fluvanilavate 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 matrixes. 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 acaris is. These fractions were 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. Pucheuex, 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 TROPHÉ project, the transfer of PCBs and PCD/Ds to plants and invertebrates has been studied: BCF in several plants and in earthworm had been measured and different methods have been calculated. Pollen contamination pattern was similar to wax matrixes. It was also possible to illustrate the impact of these differences on the contaminant concentration in interstitial water and the BCF. But this BCF, relatable to interstitial water, is not comparable with BCF measured with available guideline as OECD 317 – Bioaccumulation in Terrestrial Oligochaetes, relatable to total concentration in soil. Data obtained in the context of the TROPHÉ project allow for the comparison between PCB-PD/Fd and PCB-PD/FEarthworm measured with the OECD 317 guideline and PCB-PD/DFEarthworm extrapolated from the Kow of the substance. This 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 BCFEarthworm measured with guideline relatable to total concentration in soil and therefore unusable as such in the recommended methodology according to REACH.

MO215 Assessing risks from PBT substances in surface waters: possible alternatives to biota monitoring?


The Water Framework Directive (WFD) requires waterbodies to be at ‘good chemical status’ by meeting Environmental Quality Standards (EQSs). Normally, EQSs are expressed in water but in recent years they are expressed as critical concentrations in the flesh of aquatic biota (biota EQSs) that have been developed for some chemicals that are persistent, bioaccumulative and toxic (PBT) with the aim of protecting predators and humans from chemical exposure via the foodchain. Biota standards are now set for 11 PBT substances or groups of substances, requiring Members States to set up monitoring regimes to assess the risks to surface waters. Biota monitoring (fish or invertebrates, depending on the substance of interest) is the most relevant sampling matrix but it is destructive, and suitable biota cannot always be found where sampling is required. As a result, the coverage offered by biota sampling programmes is much less extensive than...
MO216 Risk Associated with Alternative Cleaning Method for Carrot

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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.
REFERENCES

Environmental risk assessment in time and space - new approaches to deal with ecological complexity (P)

MO218 Uncertainty concepts and misconceptions for landscape scale risk assessment
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In Europe there appears to be two opposing views on the future of ecological risk assessment of pesticides. One aims to improve ecological realism and move towards landscape scale risk assessments whereas the other aims to simplify and focus on lower tier exposure and effect assessment. To some extent this dichotomy is based on differences in uncertainty perception. Thus, one camp focuses on what we here term “in-study uncertainty” and therefore holds that higher tiers are more uncertain than lower tiers. The other camp focuses on what we term “extrapolation uncertainty” and therefore holds that higher tiers are closer to real uses in real landscapes than lower tiers are. The two views have different bases and different outcomes. The bottom line is that uncertainty cannot be ignored as it is a natural variation in real landscapes. One view holds that the effects of pesticides should be isolated from the natural variability to describe the “true” effect and, since this is difficult, holds that landscape scale risk assessments increase uncertainty. The other view holds that the effect of pesticides should be related to the natural variability and hence landscape scale risk assessments reduce uncertainty. Here we describe different components of uncertainty, what role they play in landscape scale risk assessment and we propose a way forwards for making uncertainty analysis more useful for decision making.

MO219 Concept for a regional geospatial landscape analyses to predict site specific vegetation covers
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The spatial pattern of plant communities in the agricultural landscape is depending on land management and the site specific environmental and soil conditions. In vegetation science the composition of plant species and their abundances in dependence on these factors are extensively described. This project follows the hypothesis that if the decisive environmental and soil parameters (soil type, soil texture, topography etc.) are known it should be possible to predict the vegetation cover and subsequently the composition of plant species on this site. As a starting point the main grassland types of North Rhine-Westphalia and Mecklenburg-Western Pomerania (Germany) were considered and data for vegetation communities, plant species and their frequency and abundance were imported in a PostGis database. Additionally geospatial data (shapes of grasslands, soil types etc.) were imported in this spatial database. As a second step a matrix of combinations of soil and environmental parameters was built and calibrated in ‘if-then’ steps with the main preferences of the different vegetation communities. The poster show first prediction results and discuss pro and cons of the concept as well as possible refinements in the future. The supply of data originated from these predictions could be helpful in many facets of risk assessment on a regional scale.

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

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 cereal. Rice paddy is managed by farmers: two cultivation stages: 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.

MO221 A process-based population model for algae
L. Azévedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; M. Häbekost, BASF Corporation; P. Janz, BASF SE Agrarzentrum Limburgerhof

EFSA’s guidance document for the risk assessment of edge-of-field aquatic organisms recommends a maximum of 8 weeks for the ecological recovery option (ERO) of aquatic organisms in a risk assessment for plant protection products (PPP). Here, we propose a process-based model for algal abundance to simulate effects and recovery of algal populations over time following exposure to PPPs. The model integrates the main processes driving algal cell growth, such as (1) toxicity of the PPP and (2) growth conditions: 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) guidances 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 adress 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 springtail specific food based life cycle models and derived virtual pre-equilibrium time series 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**

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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 relationship to the amount of leaching solution after variable pre-equilibrium 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 endogenous DOC in DOC unevoluted fractions. The addition of endogenous DOC increased 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; K. 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 evaluations. The toxicological sensitivity was derived by indirect prediction based on traits because sufficient data was not possible. 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**

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Assessing impacts on biodiversity needs to integrate indirect effects ( trophic chain interactions, also referred to 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. To this end, recent developments in risk assessment and modelling of fluxes in the field of macrobenthic invertebrates have been summarised in a recent publication. The relevance of different environmental conditions on springtail populations was therefore evaluated by 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 endogenous DOC in DOC unevoluted fractions. The addition of endogenous DOC increased 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.

**MO226 Compensating for ecological risks of pesticides**

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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 (soil effects). We consequently prepared a simple empirical model to 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 springtail specific food based life cycle models and derived virtual pre-equilibrium time series from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes. It has not escaped our notice that our proposal could also 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 springtail specific food based life cycle models and derived virtual pre-equilibrium time series from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

SETAC Europe 28th Annual Meeting Abstract Book
Fish model species in human and environmental toxicology (P)

MO228

Historical control data of the optimized Zebrafish Embryo Developmental Toxicity Assay (ZEDTA)
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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 was 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 sacculle/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. Beeckhuizen, 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 design has to be adapted to specific endpoints according to the OECD Guidelines. Teratogenic endpoints such as malformations of sacculle/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
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For the evaluation in ecotoxicology valid bioassays are essential for deriving Environmental Quality Standard (EQS). The generally established bioassays used 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 adequately significant particle sizes, through increasing the specificity 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
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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. Though the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still higher than those in an 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 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 of 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 Danio rerio
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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 costs they are only used in medical research, for this reason
the objective of this study was to determine the toxic and genotoxic effect of the metals Cd, Cr, Cu and Pb which are present in the freshwater systems of the valley of Mexico, on juveniles of D. rerio, to evaluate the use of these fish as biosensors in environmental monitoring studies. Static bioassays were carried out with a duration of 48 hours, with each metal. Five toxic concentrations were used in duplicate, plus a non-toxic control. The LC₅₀ was determined and with the surviving organisms the evaluation of genetic damage was carried out, by means of the evaluation of frequency of micronuclei in blood cells (1000 cells). The results obtained showed that the toxicity of metals and their mixture, based on the LC₅₀ calculated was: Cu>Pb>Mix > Cr > Cd. The Kruscal-Wallis test indicated that there are significant differences between the degree of genetic damage in exposed organisms to different metals and controls (0.004%). The metal with the highest genotoxic effect was lead (0.015%), followed by cadmium (0.065%). Copper showed the lowest genotoxicity (0.37%). The metal mixture had a minucleus frequency of 1.23%. The juveniles of D. rerio had deleterious effects in concentrations of metals lower than 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.

MO233 Enzyme disruption effects of bisphenol S and bisphenol SIP in adult zebrafish (Danio rerio) K. Ji, J. Lee, Yongin University As alternative compounds of bisphenol A (BPA), bisphenol S (BPS) and 4-hydroxyxylphenylisopropyl sulfone (BPSIP) are widely used in thermal paper products. These compounds have been detected in human urine samples; however limited information is available on their endocrine disrupting effects. Adult zebrafish pairs (Danio rerio) were exposed to environmentally relevant concentrations (0, 0.5, 5, and 50 μg/L) of BPS and BPSIP for 21 days, and the adverse effects on egg production, levels of sex steroid hormones, and transcription of genes related to hypothalamic-pituitary-gonadal (HPG) axis were investigated. The estrogenic (increase in β-estradiol/estosterone [E2/T] ratio) and anti-androgenic (decrease in T) effects were commonly observed in zebrafish exposed to BPS and BPSIP, and males were more sensitive to the adverse effects than females. Although the effective concentration for endocrine disruption was greater than that of BPS, the actions of BPSIP on the steroidaligic pathway were similar to the effects of BPS exposure. The commonalities and differences in the toxicity of BPS and BPSIP can be explained by their chemical structure: the phenolic hydroxy group is the key structural component responsible for the estrogenic and anti-androgenic activities of bisphenol analogues. The results of the present study showed that exposure to low level BPS and BPSIP could affect regulatory systems of HPG axis in zebrafish at environmentally relevant concentrations.

MO234 Oxidative Stress Induced by PAH Metabolism: Comparing Three Exposure Routes in Red Drum, Florida Pompano, and Southern Flounder to DWH surrogates D. Wetzel, Mote Marine Laboratory / ELF, R. Medvecky, C. Miller, K. Main, T.A. Sherwood, Mote Marine Laboratory The magnitude of the oil and dispersant released during the Deepwater Horizon blowout caused significant immediate, and often lethal, damage to exposed organisms. However, the sub-lethal impacts of the chronic spill on offshore and nearshore biota are still not fully characterized. To help understand one of the most significant responses in important Gulf fish species, four different exposure routes were investigated. The actions of BPSIP on the steroidaligic pathway were similar to the effects of BPS exposure. The commonalities and differences in the toxicity of BPS and BPSIP can be explained by their chemical structure: the phenolic hydroxy group is the key structural component responsible for the estrogenic and anti-androgenic activities of bisphenol analogues. The results of the present study showed that exposure to low level BPS and BPSIP could affect regulatory systems of HPG axis in zebrafish at environmentally relevant concentrations.

MO235 Induction of developmental cardiotoxicity in rainbow trout (Oncorhynchus mykiss) following PAH mixture exposure - new insights using an integrated OMICS approach. A.N. Eriksson, C. Rigaud, University of Jyväskyla / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; I. Liňalainen, University of Helsinki; A. Ronkka, S. Saraei, T. Suomi, A. Laiho, L. Elo, University of Turku and Åbo Akademi University; E. Vehniäinen, University of Jyväskyla / Department of Biological and Environmental Science

Worldwide, environmental levels of polycyclic aromatic hydrocarbons (PAHs) have increased over the last century, mainly due to anthropogenic release from incomplete combustion of organic material and oil spills. These compounds are present as a complex mixture in the environment and are known to cause developmental abnormalities, cardiotoxicity, immunosuppression, tumors, and alterations in reproductive systems. In vitro, PAHs can cause cell death (apoptosis) and cell cycle arrest through oxidative stress and DNA damage. These endpoints have been shown to be significantly increased when PAHs are in the presence of other chemicals, suggesting the potential for a synergetic effect. Furthermore, the toxicity of PAHs and their mixture may be linked to the particular PAH in the mixture, its concentration, and the presence of co-exposures.

Our study examined the effects of PAH exposure on heart development in rainbow trout (Oncorhynchus mykiss) embryos (ZFEs). ZFEs (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 (BFl) and 6H-benzo[c]pyrene-6-one (6H-BPO)) or their binary mixture for 4 days. After exposure, ZFEs 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 expression of genes related to NPPA, BNP, cardiac myosin and cardiac troponin was significantly increased, in a dose-dependent manner, in ZFE 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 BFlO and 4H-CPO in mixture with BP. Gene expression analysis showed significant up-regulation of genes related to NPPA and cardiac troponins. These findings provide new insights into the adverse effects of PAHs on heart development and cardiotoxicity in rainbow trout (Oncorhynchus mykiss) embryos.
includes detoxification enzymes induction (CYP1A), hemorhagia, cardiovascular defects, pericardial and yolk sac edemas, craniocaudal 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 phenoxybenzotriazole can activate this receptor, for example, via unknown AhR-independent mechanisms. In this study, we aimed to explore the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhyncus 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 and further exploring their mechanism of toxicity. Newly hatched 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 involved in several pathways, for example, 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. Ezemonye, University Benin / Animal and Environmental Biology. N.O. Ezemonye, 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 µgL⁻¹) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural effects on the embryos were observed. Exposure of the embryos by acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisoning 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**

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The contaminated Sites of National Interest (SIN) in Italy, are characterized by environmental degradation, determined by the impact of industrial activities during the last decades. The primary objective of the project CISAS “International Centre of Studies and Research on human health and the environment” is aimed to understand the mechanisms underlying the interaction between conventional (heavy metals, POPs, radionuclides, etc.) and emerging contaminants (e.g., PBDE, antibiotics, pharmaceuticals, antitumourals, etc.) from the environment to ecosystem, through a multidisciplinary approach. The goal of our study was to investigate, in vitro, 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 environment 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 molecular 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 CISAS “Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana” (CUP B62F15001070005) is funded by CIFE- MIUR.

**MO240**

**In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhyncus mykiss) proteins.**

D. Deol Esposti, Irsita / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Irsita / Laboratoire de Toxicologie; R. Casadio, University of Bologna / Department FaBit; M.P. Babut, Irsita / Water Perfluorooalkyl substances (PFASs) represent an important class of environmental contaminants which have been widely detected in humans and wildlife as well as in surface waters and aquatic sediments. PFCS have been shown to accumulate in aquatic species and some of them have displayed reproductive and development toxicity, hepatotoxicity and behavioral effects. Numerous studies in fish and mammals have demonstrated higher PFC concentrations in liver and blood compared to other organs. Such a distribution could be explained by PFAS binding to specific proteins, in particular the L-FABP (Liver-Fatty Acid Binding Protein) and the serum albumin. However, the data concerning the binding affinities of PFASs to these specific proteins are rare, refer mainly to mammalian proteins and to only one compound one of the main halogenated PFAS in fish. Moreover, biochemical in vitro approaches are often not possible due to the lack of purified proteins for most common fish species. The use of in silico approaches such as protein structure modeling and molecular docking between the chemicals and the proteins of interest, may improve our ability to evaluate chemical-protein interaction and allow the extrapolation of biochemical parameters, such as binding constants. This kind of data would be helpful in building more refined toxicokinetics model in aquatic organisms. Here we present a simple two-step method based on protein modeling followed by molecular docking using free online tools. We inferred dissociation constants for 3 different perfluorooalkyl acids (Perfluorooctane Sulfonate, PFOS, perfluorohexane sulfonate, PFHxS) to 3 known mammalian proteins, L-FABP and human albumin. Comparison with experimental data on the human protein showed that this approach provides estimates that range in the same magnitude as those obtained by experimental approaches, such as ligand displacement assays.

**MO241**

**Impact of metformin on zebrafish (Danio rerio) embryos**

S. Mieck, University of Heidelberg / Aquatic Ecology and Toxicology; T. Brauneck, University of Heidelberg / Centre for Organisinal Studies

The biguane metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its anti-hyperglycemic effect, metformin is one of the most abundantly prescribed medicinal 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 organism 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,NH₄ x HCl) according to OECD test guideline 216 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. ’n

**MO242**

**Pyrogallol and its structurally related compounds on animal cytochrome c oxidase 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 pyrogallol is a benzenetriol being a brownish solid, and is used for hair dyes after treatment with copper sulphate. A recent report on mutagenicity of pyrogallol-containing hair gels has demonstrated that there was no 2-fold increase in reverters 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 oxidase (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, pyrogallol was the strongest chemical among the tested chemicals (94% inhibition of COX activity with the concentration of 20 ppm). Gallic acid and 1,2,4-benzenetriol showed potent inhibition on the COX activity with the concentration of 100 ppm. At a 10-times diluted concentration, these three compounds showed moderate inhibition on the enzyme activities. These phenomenon were applied all of the tested animals. Pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid did not show any inhibitory effect on the COX activity. Taken together, benzenetriols including pyrogallol may be caused 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; T. Tuchinov (TCS, 5-chloro-TS, 1,2,4-dichlorophenoxyn 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 Waste Water 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. There is evidence 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 of 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-S-transferase (GST) and glutathione peroxidase (GPX) activities 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

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Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria in surface waters. In this study, we used a Microcystis aeruginosa bloom extract consisting of the environmental concentrations of TCS (0.1 g/L) and MC-LR for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of MCs 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-S-transferase (GST) and glutathione peroxidase (GPX) activities 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.

MO245

Subchronic toxicity of a Microcystis aeruginosa bloom extract containing mainly the microcystin-LR congeners on the common carp Cyprinus carpio

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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 juveniles (200 g) of common carp (Cyprinus carpio). The fishes were been randomly assigned to three groups. Group I, 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 by histological observations and biometrical analysis. The results obtained showed that the two sublethal concentrations, 2 and 10 μg equivalent MC-LR/kg body weight, increased the expression of inflammatory markers, caused an important decrease of GSH and the GPx activity. In addition, the hepatopancreas, kidneys, intestine and gills of fish exposed to the MC-LR showed signs of hemorrhage and inflammatory infiltrates in all organs. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated by histological observations and biometrical analysis. The results obtained showed that the two sublethal concentrations, 2 and 10 μg equivalent MC-LR/kg body weight, increased the expression of inflammatory markers, caused an important decrease of GSH and the GPx activity. In addition, the hepatopancreas, kidneys, intestine and gills of fish exposed to the MC-LR showed signs of hemorrhage and inflammatory infiltrates in all organs. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated by histological observations and biometrical analysis. The results obtained showed that the two sublethal concentrations, 2 and 10 μg equivalent MC-LR/kg body weight, increased the expression of inflammatory markers, caused an important decrease of GSH and the GPx activity.
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Cytochrome P450 (CYP) enzymes are dominant players in metabolism of xenobiotics and a wide range of endogenous compounds. Skatole is well known mammalian metabolite, however rarely considered as environmental relevant pollutant. In fact, presence of skatole in animal feed is known to cause organ toxic effects to some organisms due to its biological effects. To the best of our knowledge, no studies attempted to investigate the effect of skatole and its major metabolites on piscine CYPs. The aim of this study was to identify water skatole and its metabolites, 2-aminoacetoephone, indole-3-carbinol, 3-methylindole, and 3-hydroxy-3-methylindole, can interact with fish CYP isozymes. Enzyme activities for CYP1A and CYP2A in rainbow trout hepatic microsomes were measured in the presence or absence of skatole and its metabolites. Following concentrations of tested inhibitors were used: 0.5; 5 and 50 µM. Skatole and indole-3-carbinol showed no inhibition potency on either CYP1A or CYP2A, 2-Aminoaacetophenone, 3-methylindole and 3-hydroxy-3-methylindole reduced CYP1A enzyme activity by approximately 25-35%, whereas CYP2A activity remained unaltered. Physiological consequences 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.

MO248 Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights
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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 geneexpression 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 survival. 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
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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) by xenobiotic 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 waste water treatment plant (WWTP), were screened on a set of recently identified NRs and AhR.

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Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
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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 (WWTP), sewershers and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgent to evaluate its 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 interpret 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 hightroughput testing strategy, incorporating different determinands, 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 (Tg:LFABP: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 s 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, nucleotides etc.) was established, covering a broad range of primary metabolism. Consequently, it is urgent to evaluate its potentially toxic effects to aquatic organisms.
extract was then centrifuged, filtered and reconstituted in methanol. Separations were performed on C18 (2.1 mm x 50 mm, 3.5um 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 for classes 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 microinjection 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. Bhum, University of Saskatchewan / School of Environment and Sustainability; D.M. Janz, K. Liber, L.E. Doig, 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 a particular risk for a detrimental maternal transfer of Se. The aim of this study was 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 short-lived fish species. Next, all the embryoinjection 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 rainbow trout. A preliminary assessment revealed an increasing, although not significant, trend in the frequency of deformities between the control and high treatment groups (p=0.057); however, a more robust analysis is on-going. 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 studying the maternal transfer of Se. This approach may also have potential for determining endpoint values that can be used for risk assessment and regulation.

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 (Oncorhyncus 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 expression 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 pattern changed markedly for 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 also 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 Universitet / MTM Research centre; N. Scherbak, 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 vertebrates. However, it is of particular interest since epigenetic changes were reported in zebrafish with increasing 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 (MXY), permethrin (PER)), plastic additivies (bisphenol A (BPA) and S (BPS)), perfluorinated compounds (perfluoroocetic sulfonic acid (PFOS), perfluorobutane sulfonic acid (PFBS)), a whitening agent, 7-dihydrinole-4-methylcoumarin (DEM)); and to the potential variability values of polybrominated diphenyl ethers (PBDEs). Differences in protein expression were analyzed with 2D-PAGE and mass spectrometry. The results showed that FZ-L cells were responsive to epigenetic disruption. They brough further 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 Cross-species applicability of the adverse outcome pathway "deiodination inhibition leading to impaired swim bladder inflation in zebrafish" E. Stinckens, University of Antwerp; L. Vergauwen, 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. Knaup, 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 compounds and extending the AOP to other fish species (e.g. rainbow trout, Atlantic salmon) which are attractive models for testing the AOP in vivo endpoints. We were able to demonstrate that the in chemico dataset can be used to effectively predict effects on swim bladder inflation. For a limited number of compounds however, zebrafish responded differently than what was expected. In this presentation, we will assess these outliers by examining (1) the cross-species applicability of our AOP-based assays, (2) toxicological mechanisms other than thyroid disruption that could result in effects on swim bladder inflation. We performed in vitro DIO assays for 20 compounds using porcine, rat and fish liver homogenates to characterize similarities and differences among species. Results show that the DIO1 inhibitory potential is nearly identical between the selected species. However, a set of bisphenol A derivatives showed lower inhibition in fish compared to pig. In addition, we performed qPCR analysis of a set of 29 genes related to thyroid metabolism and swim bladder inflation after exposing zebrafish to 4 compounds for which false negative predictions were observed. These results suggest that PFOS affects surfactant properties which could impact swim bladder inflation. SMX affected genes related to the development of the 3 cell layers of the swim bladder, suggesting that this compound inhibits swim bladder development. Our results suggest that different species, different compounds, tissue originating from different vertebrate species can be used in the DIO assay to predict apical outcomes in fish. However, it is expected that any predictive model based on measuring only few molecular initiating events could be refined as knowledge on the involvement of other specific thyroid related processes in swim bladder inflation grows. In addition to the fact that differences in predicted effects may be observed as a result of cross-species differences, many different toxicological mechanisms can lead to swim bladder inflation effects as well.
Zebrafish responses to the fourth-generation progestin drospirenone exposures

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Synthetic progestins (PGs) represent an important class of active ingredients of hormonal medicines/pharmaceuticals. In addition to its endocrine activity, it is known that DRP can interfere with other processes in fish, such as regulation of circadian rhythm. Thus, the present work aimed 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 hatchings were evaluated in a morphological and physiological endpoints. Alterations on enzymes regulated 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 in a number of chemicals that were identified as DRP-specificity 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: upstream, discharge point. A downstream of 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 adverse physiological effects. Therefore, stress marker enzyme assays (catalase, carboxylesterase and glutathione t-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytochrome oxidase subunit 1 (COX1), metallothionein (MT), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor α (ERα), estrogen receptor β (ERβ), androgen receptor (AR), cortisol receptor (CR) and vitellogenin (VTG) as endocrine disruption related genes; interleukin1β (IL1β) and tumor necrosis factor (TNFα) as immune response related genes, while light chain 3 (LC3) 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 responsive gene at downstream site follow the trend of overexpression vs control (reference site), while the VTG was down-regulated at discharge point. Expression of TNF 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 endocrine 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


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). Differences in expression of thyroid-related genes were identified and compared with previous studies. In addition to its endocrine activity, it is known that DRP can interfere with other processes in fish, such as regulation of circadian rhythm. Thus, the present work aimed 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 hatchings were evaluated in a morphological and physiological endpoints. Alterations on enzymes regulated 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 in a number of chemicals that were identified as DRP-specificity 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: upstream, discharge point. A downstream of 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 adverse physiological effects. Therefore, stress marker enzyme assays (catalase, carboxylesterase and glutathione t-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytochrome oxidase subunit 1 (COX1), metallothionein (MT), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor α (ERα), estrogen receptor β (ERβ), androgen receptor (AR), cortisol receptor (CR) and vitellogenin (VTG) as endocrine disruption related genes; interleukin1β (IL1β) and tumor necrosis factor (TNFα) as immune response related genes, while light chain 3 (LC3) 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 responsive gene at downstream site follow the trend of overexpression vs control (reference site), while the VTG was down-regulated at discharge point. Expression of TNF 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 endocrine disruption and are in line with the results observed in vitro.

MO260
Skin vitellogenin and estrogen receptor as sensitive biomarkers of estrogenicity in a sub-Antarctic fish.


The fast expansion of socio-economic activities on coastal areas has increased the presence of anthropogenic pollutants from industrial and domestic sources over the last decades. Recent studies have reported the presence of many persistent organic pollutants in water, sediments and in vertebrates from Antarctic areas; however, information about their potential impact on fish physiology is still scarce. The southernmost city of the world, Ushuaia (Tierra del Fuego, Argentina), and its bays are not the exception to the decline of the environmental quality. Nototobith fish are the dominant group of the coastal ichthyofauna of Antarctic waters and evaluate environmental risk in the intertidal zone, and possess paternal care. The aim of the present work is to validate vitellogenin (VTG) and estrogen receptor (ER) as biomarkers of estrogenicity in skin samples of this species in order to provide a helpful tool to develop and perform experiments with new and existing environmental risk in places where contamination already exists. Male fish were injected with 17β-estradiol (i.p, single dose of 10 mg/g or vehicle). Vitellogenic females were used as positive controls. Samples of skin and liver were obtained to assess VTG toxicity at different levels of biological organization.
vtg-ir bands similar to those of females. Likewise, plasma E2 concentration in males was significantly increased but the opposite was observed in T levels. These changes were also reflected in E2:T ratio. Furthermore, E2 levels in treated males were even higher than those of females. Vtg and ERα gene expression was up-regulated both in liver and skin after E2 treatment. Potential impact in parental behavior is discussed. We conclude that vtg and ERα expression in skin are sensitive and non-harmful biomarkers of estrogenicity in this Sub-Antarctic fish.

MO261 Thyroid disruption and its effects on neuronal development of zebrafish A. Hagen, A. Masse, N. Baldwin, N. Brinkmann, University of Saskatchewan / Toxicology Centre; 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 Centre / Toxicology Centre; D. Green, University of Saskatchewan - Toxicology Centre / Toxicology Centre; 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; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; N. Baldwin, Gill University / Agriculture and Environmental Science; N. H. Hogan, University of Saskatchewan / Toxicology Centre and Department of Animal and Poultry Science, College of Agriculture and Biosources; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Chlorpyrifos is an organophosphate insecticide that acts as a neurotoxicant through inhibition of the enzyme cholinesterase. The mode of action of organophosphates in target and non-target organisms, including mammals, is similar. The aim of the project is to develop an early-life-stage gene expression assay (EcoToxChip) that captures critical toxicity pathways of chlorpyrifos for the prediction of apical outcomes of regulatory relevance. As this assay is intended to use early-life-stages that are not feeding independently, it would not be considered as a live animal test, and therefore, would address the need for alternative approaches in chemical screening. As part of the project, critical toxicity pathways and associated core genes will be identified following exposure of fathead minnows (Pimephales promelas) at early life-stages to three sub-lethal concentrations of chlorpyrifos. Specifically, sequence-by-synthesis-based whole transcriptome (RNASeq) and high-throughput genome-based expression analysis will characterize key molecular toxicity pathways. Pathways will then be correlated with downstream biological responses of ecological and regulatory relevance, and critical genes linked to apical outcomes will be identified for inclusion on EcoToxChips. Chlorpyrifos concentrations were selected based on a preliminary test as well as concentrations in published data. These tests revealed a threshold level of mortality between 1 and 10 µg/L chlorpyrifos. To ensure the determination of solely sub-lethal effects in at least two of the tested concentrations, 0.5, 1.5 and 4.5 µg/L chlorpyrifos solutions were investigated in the fathead minnow early-life-stage assay with larvae samplings after 7 and 32 days of exposure. None of these concentrations affected survival or growth, resulting in a sub-chronic NOAEC and LOAEC of 4.5 and 10 µg/L chlorpyrifos, respectively, in fathead minnows. Samples are currently being further analyzed for molecular and physiological endpoints to gain insight into critical toxicity pathways. This study is part of the EcoToxChip project (@ecotoxchip).

MO264 Evaluation of the deleterious effect of 2 pesticides on juveniles of the zebrafish Danio rerio G. Geraldo Morales, Universidad Autónoma Metropolitana Iztapalapa / Departamento de Hidrobiología; A. Sobrino-Figueroa, Universidad Autónoma Metropolitana Iztapalapa / Hidrobiología

In the present study an evaluation of the toxic effect of 2 pesticides: Dichlorvos which is an organophosphorus insecticide, used for the control of ectoparasites in fish, and insecticide Imiprotrin belonging to the group of pyrethroids, used as a main component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (liperoxidation), the activity of the enzyme acetylcholinesterase (AchE) and the production of macromolecules (proteins, lipids and carbohydrates). Initially a test (96 hrs) was made, where zebrafish juveniles were exposed to 5 concentrations of pesticides (10, 1, 0.1, 0.01, 0.001, 0.0001 mg L⁻¹) to determine the 50 lethal concentration (LC₅₀). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC₁₀ and LC₅₀). The resorption of oocytes show that pesticides and mixtures (LC₅₀ = 1.67 ± 0.87 mg L⁻¹); 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 liperoxidation in the imiprotrin tests varied from 64.7 to 147.5 m Nm Tbars mg⁻¹ and was higher than that observed in the bioassays with dichlorvos (22.6 to 93.8 m Nm Tbars mg⁻¹). In the fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of AchE 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.

MO265 Effects of Omeprazole on zebrafish embryos (Danio rerio) A. Sobrino-Figueroa, Universidad Autónoma Metropolitana Iztapalapa / Hidrobiología; J. Salazar Hernández, Universidad Autónoma Metropolitana Iztapalapa / Biología

Omeprazole is a proton pump inhibitor, it is used for the control of gastritis, for this reason it is one of the most prescribed drug, consumed by millions of people in the world. This drug has been associated with acid rebound hypersecretion, decreased food intake in mice and rats, and decreased weight gain in mice and rats. These effects indicate that Omeprazole has a neurotoxic and possibly genotoxic effect. In this study an evaluation of the toxic effect of 2 pesticides: Dichlorvos which is an organophosphorus insecticide, used for the control of ectoparasites in fish, and insecticide Imiprotrin belonging to the group of pyrethroids, used as a main component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (liperoxidation), the activity of the enzyme acetylcholinesterase (AchE) and the production of macromolecules (proteins, lipids and carbohydrates). Initially a test (96 hrs) was made, where zebrafish juveniles were exposed to 5 concentrations of pesticides (10, 1, 0.1, 0.01, 0.001, 0.0001 mg L⁻¹) to determine the 50 lethal concentration (LC₅₀). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC₁₀ and LC₅₀). The resorption of oocytes show that pesticides and mixtures (LC₅₀ = 1.67 ± 0.87 mg L⁻¹); 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 liperoxidation in the imiprotrin tests varied from 64.7 to 147.5 m Nm Tbars mg⁻¹ and was higher than that observed in the bioassays with dichlorvos (22.6 to 93.8 m Nm Tbars mg⁻¹). In the fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of AchE 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.

MO266 The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges M. Fenske, Fraunhofer Institute for Molecular Biology and Applied Ecology IME / SETAC Europe 28th Annual Meeting Abstract Book

Venlafaxine is a member of the antidepressant group known as the serotonin-norepinephrine reuptake inhibitors (SNRIs). These compounds are used for the treatment of various mood disorders and anxiety. Venlafaxine has been found in human sewage effluents in the range of 10-400 ng/L and is considered as an emerging environmental contaminant. In our previous study, we evaluated the effects of Venlafaxine on the cholinesterase activity and the histology of the brain in adult fish. The results showed that Venlafaxine significantly decreased the AchE activity and increased the number of pyknotic cells in the brain. In the present study, we investigated the effects of Venlafaxine on the brain development of zebrafish embryos. We used omics technologies, including transcriptomics and proteomics, to identify the genes and proteins that are differentially expressed in response to Venlafaxine. We found that Venlafaxine significantly altered the expression of genes involved in the development and function of the nervous system. These findings suggest that Venlafaxine may have neurotoxic effects on the developing brain. However, the mechanisms by which Venlafaxine affects the nervous system are not well understood and further research is needed to clarify these effects.
year. Considering the ecosystem services/principle, effects on single species, communities and whole ecosystems would increase that up 'to' hundred times, similarly to when considering other chemicals such as neuroactive pharmaceuticals. 'Antidepressants such venlafaxine are of increasing environmental neurotoxic concern. Venlafaxine is one of the most prescribed antidepressants in Europe and the U.S. and a known aquatic pollutant. It has a serotonin-norepinephrine reuptake inhibitor, increasing serotonin and norepinephrine concentrations in brain regions. It was also shown to affect monoamine levels and cause behavioral alterations/unin fish. The aim of this study was to analyze the neurotoxic potential of Venlafaxine on zebrafish 'nlarvae by evaluating transcriptomic profiles and behavioral alterations. The locomotor activity in 'un' light-dark transition test and thigmotaxis were evaluated in 5 dpf larvae exposed to 24 h to 1 mM, 100 nM and 10 µM venlafaxine using DanioVision® and EthoVision. A significant difference/un in the swimming behavior concerning the different concentrations could be detected. Effects on the transcriptome level were verified in zebrafish continuously exposed to Venlafaxine in 1 nM, 100 nM up to 120 hpf. RNA was extracted from pooled samples (n = 25 fish) and submitted to Sybr Green quantitative real-time chain reaction (qPCR). It was based on target gene selection and the correlation factors involved in circadian rhythm regulation, muscle processes and responses 'unto' abiotic stimuli. Behavioral results indicated decreased swimming distance and increased thigmotaxis 'un' exposed fish, in agreement with previous own data for continuous venlafaxine exposure. Results 'un' for qPCR indicated modulation of some of the pre-selected target genes such as sklp5, and currently 'un' confirmed qPCR and mRNA sequencing. Further investigations on zebrafish larvae were planned at 0 or 1000 mg/L during 96 h of exposure. The effects on locomotor activity of zebrafish larvae were assessed using the automated video tracking system Zebrafish at 0 to 20 mg/L and after 120 and 144 hours of exposure. The ayahuasca infusion was administered once by gavage to Wistar rats at 1, 5 and 15 times the dose taken during a religious ritual, and neurobehavioral effects evaluated after 2 hours in the open field (OF), elevated plus-maze (EPM) and forced swimming (FST) apparatus. The LC50 of ayahuasca in zebrafish was estimated to be 236.3 mg/L. Ayahuasca exposure caused significant developmental anomalies in zebrafish embryos, mainly at the highest concentration tested, including hatching delay, loss of equilibrium, edema and accumulation of red blood cells. The behavior of embryos was also significantly affected, with a decrease in locomotor activity at the highest tested concentration. Decreased locomotion was also observed in the rats treated at the highest dose in the OFT and EPM, and a higher swimming time in the FST, suggesting a possible antidepressant effect. These results indicated that the effects of ayahuasca correlated well for zebrafish embryos and rodents, showing that zebrafish may provide a useful model to study ayahuasca and other hallucinogenic drugs. Lab-based research focusing on the molecular pathways affected by ayahuasca administration in both zebrafish and rat models could provide additional information on the potential of ayahuasca as an antidepressant. Acute effects of the ayahuasca infusion ('Banisteriopsis caapi and Psychotria viridis') on zebrafish and rodent models

MO267 Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
T.S. Andrade, Universidade de Brasília / 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. Dominguez, 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 / Laboratory of Toxicology, Faculty of Health Sciences; and J. Legradi, Ecosystem Analysis (ESA); M. Spehr, B. Kampa, RWTH Aachen University; H. Hollett, RWTH Aachen University / Institute for Environmental Research The societal impact of neurological disorders like Alzheimer’s disease or neuropsychiatric deficits like depression or schizophrenia is enormous. The molecular markers, 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 pharmaceuticals. It is a principle, effects on single species, communities and whole ecosystems would increase that up 'to' hundred times, 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 pharmaceuticals. Currently, testing for neurotoxicity is not required within the EU (REACH) as it is not confirmed how to assess such compounds in vitro. Considering the e

MO268 Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish.
N. de Farias, Universidade de Brasilia / Departamento de Genética e Morfologia; R. Oliveira, State University of Campinas / Department of Genetics and Morphology; T.S. Andrade, Universidade de Brasília / Laboratory of Genetic 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 of 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 decrease of glycogen and progressive loss of hepatic architecture. The pattern of swimming behaviour 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
L. 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 environmental chemical exposure has attracted great attention on toxicological 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 XF 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 dataset could suggest the role of each OCP and their mixtures in the development of an integrated 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
I. Lee, Vrije Universiteit Amsterdam; A. Haigis, Institute for Environmental Research RWTH Aachen University; M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); S. Lee, Seoul National University of Science and Technology / Environmental engineering; H. Hollett, RWTH Aachen University / Institute for Environmental Research The societal impact of neurological disorders like Alzheimer’s disease or neuropsychiatric deficits like depression or schizophrenia is enormous. The molecular markers, 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 confirmed how to assess such compounds in vitro. Considering the e

MO271 Ecotoxicological assessment of psychiatric drugs.
E. Marschall, RWTH Aachen University / Department of Toxicology / Environmental Toxicology and Health and Skin Toxicology; C. Koppe Grisolia, RWTH Aachen University / Laboratory of Toxicology, Faculty of Health Sciences; and M. Ruiz, RWTH Aachen University / Department of Toxicology / Environmental Toxicology and Health and Skin Toxicology The bmbf funded project NeuroBox ((02WRS1419; coordination B. Kampa, RWTH Aachen University / Department of Toxicology / Environmental Toxicology and Health and Skin Toxicology) aims to develop novel assessment strategies for neurotoxicity assessment of pharmaceuticals and neuroactive substances in water 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
changes were observed ad concentrations below any phenotypic changes could be observed. Our results so far show that assessing neurotoxicity is complex and a tiered approach covering behavioral tests in combination with OMICS techniques seem to be a cost and time efficient way.

MO271
Understanding the correlation between behavioural inter-individual variability and physiology/morphology in zebrafish larvae
K.T. Kiria, C.M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology
Background: Zebrafish are widely used in biomedical research as they offer several features such as the fully sequenced genome, availability of a wide range of mutants and genotypes of different strains, ability to culture a large number of individuals in a small space and preserved vertebrate drug targets to a great extent. Early stages of zebrafish are called as non-protected life stages and are therefore used for testing chemicals for their toxicity as an alternative to conventional animal testing. Moreover, zebrafish larvae are amenable to test neurotoxicity and behavioural effects of chemicals as their small body size allows tracking a large number of individuals with full control over the environment. Aim: The aim of the project is to investigate behavioural inter- and intra-individual variability in zebrafish larvae as a basis to better estimate effects of chemicals on behavioural responses. Analysis of inter-individual differences might offer new insights into mechanisms of toxicity considering that every individual’s response to a chemical differs based on their genetic make-up.
Hypothesis: We are testing whether inter-individual variability is constant over time and whether levels of locomotor activity correlate with physiological and morphological properties of the larvae. Methods: At first, spontaneous locomotor activity is measured for 40 min in continuous light at different timings of the day from 5-7 days post fertilization. Heart rate, body size and other physiological properties of the same individuals are analysed at different time points. Results: From the preliminary results of the locomotor activity analysis, we could assign the larvae to three categories based on their activity levels compared to the average activity: highly active, less active and the individuals close to the average activity, which are also the ones less variable over time. To attribute this variability in the individual’s activity to its physiology and phenotype, the analysis of heart rate, length and blood flow are on-going. Outlook: The variability of each individual will be taken into account to better evaluate effects of the chemicals on behavioural responses. Inter-individual differences will be explored as a source of information on mechanisms of toxicity of chemicals with unknown targets and mode of action.

MO272
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (P)

MO273
The use of a polymer inclusion membrane for the determination of arsenate by gas-diffusion flow analysis with spectrophotometric detection
R. Vera, University of Girona / Chemistry; C. Fontas, University of Girona / Department of Chemistry; M.G. Almeida, The University of Melbourne / School of Chemistry; E. Antico, University of Girona / Department of Chemistry; R.W. Catrall, S.D. Kolev, The University of Melbourne / School of Chemistry
Arsenic is a naturally occurring toxic element, which is present in waters in different areas around the world, including South Asia, South America and to lesser extent Europe [1]. Therefore, the World Health Organization has set the guideline concentration for arsenic in drinking water at 10 µg L⁻¹ [2]. The most frequently encountered arsenic species in environmental and drinking waters is arsenate (As(V)). Therefore, highly sensitive analytical techniques are required for its determination in water samples. In the present work a novel flow analysis (FA) system has been developed for the determination of As(V) in environmental and drinking waters at the low µg L⁻¹ level. The system uses a polymer inclusion membrane (PIM) [3] held in a poly(vinylidene fluoride-co-hexafluoropropylene) as the polymer and Aliquat 336 as the extractant, for the online preconcentration and separation of As(V) in a PIM cell. The sample solution is propelled for a predetermined period of time through the PIM cell where a PIM separates the sample stream and an acceptor stream which is stopped during the sample passage through the PIM cell. The As(V) preconcentration in the static acceptor solution located in the acceptor channel of the cell. The analytical procedure involves a 15 min stop-flow time and sample solution flow rate of 2.5 ml min⁻¹. After the stop-flow time the acceptor stream is re-started and As(V) is reduced to arsenite (As(III)) by merging the acceptor stream with a reagent stream containing 4 M HCl, 1% FA and 0.5% ascorbic acid. This is followed by arsine generation using another reagent stream incorporating 0.5% NaBH₄ and 0.05 M NaOH. The generated arsine is transported across the hydrophobic membrane of a gas-diffusion cell into a solution containing 0.02 M KMnO₄ and 0.05 M NaOH where it is oxidised thus producing a decrease in the KMnO₄ absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system has a detection limit of 4.4 × 10⁻¹⁰ g L⁻¹, a repeatability, expressed as RSD of 1.8% (n=5, 25 µg L⁻¹) and a sampling rate of 2.5 h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 µg L⁻¹) and a sampling rate of 2.5 h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 µg L⁻¹) and a repeatability, expressed as RSD of 1.8% (n=5, 25 µg L⁻¹) and a repeatability, expressed as RSD of 1.8% (n=5, 25 µg L⁻¹). The FA method has been successfully applied to the determination of As(V) in tap water in the µg L⁻¹ concentration range. <strong>References</strong> [1] Villaescusa I, Bollinger JC. 2008. Arsenic in drinking water: sources, occurrence and health effects (a review). Rev Environ Sc Technol 33:307–323. [2] Volyen R, Kramer R. 1984. Environmental Quality Standards and Guidelines for Drinking-Water, Third edition. World Health Organization (WHO). 2001. Guidelines for drinking-water quality, 4th edition

MO274
Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers
V. P. Gimeno Melia, Catalan Institute for Water Research (ICAR); J. SEVERYN, AQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICAR, Spain
Investigations of upgrading wastewater treatment plants (WWTPs) with tertiary treatment to reduce microcontaminants loads in surface waters at a catchment scale can be daunting. Our hypothesis was that these investments seriously change upon selection of the Environmental Quality Standards (EQS) for unregulated microcontaminants, and hence there is a trade-off between EQS selection and investment which needs to be considered in decision-making. We used a customized Microcontaminant Fate and Transport Model coupled to an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and dichloroacetic as the unregulated microcontaminant. The algorithmized the selection of WWTPs in this catchment requiring an upgrade to optimize the EQS exceedance of dichloroacetic in a cost-minimal way. We simulated 40 scenarios representing a combination of 4 potential EQS which are currently being discussed in the European Union (10, 30, 50 and 100 ng/L), 5 levels of uncertainty bounds in the predictions of river concentrations and 2 hydrological scenarios (average flows and low flows). The results showed that the optimized selection of WWTPs in the Llobregat river basin was 8 M€/year (upgrading 8 WWTPs out of the existing 56 for fulfilling an EQS of 30 ng/L in the entire catchment). Such an investment seriously changed upon selection of EQS. The cost varied from 6 M€/year (upgrading 3 WWTPs for fulfilling an EQS of 100 ng/L) to 13 M€/year (upgrading 18 WWTPs, for fulfilling an EQS of 10 ng/L). We observed that the selection of catchment hydrological conditions during the upgrading analysis also plays a key role. The cost of the upgrades when considering low surface water flows (minimum environmental flows that ensure compatibilization of environmental needs and human water consumption) was 50% higher than the cost obtained with average flows (average...
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 use) in waste water, 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 waste water treatment plants (WWTP).

This study was realized by a French team (INSU / SENEUR Project and Thermo Fisher Scientific / Chromatography and mass spectrometry division)

Perchlorate has been found to cause thyroid dysfunction, and has been linked to

Scientific; J. Rohrer, Thermo Fisher Scientific / Chromatography and mass spectrometry division

B. Huang, Thermo Fisher Scientific / marketing; S. Bieber, Technical University of Munich / Chair of Urban Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich / Chair of Urban Water Systems Engineering

MO276 Passive sampling in surface water as an immission-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg. T. Galle, Luxembourg Institute of Science and Technology; D. Pitois, M. Bayerle, Luxembourg Institute of Science and Technology List

The pressure on surface waters that is exerted by emerging pollutants depends on the loads arriving at treatment plants and the elimination capacity of the latter. Both can be variable depending on the compound, the contributors of the sewer network as well as the design and operation of the treatment plant. Several emerging compounds have mixed uses and can therefore stem from domestic as well as from industrial sources. Regulators have an interest in knowing immission situations that will probably lead to EQS exceedences without needing to monitor emerging substances in the whole hydrological network. So, one of the major analytical techniques used in a diverse range of applications. Despite this, GC-MS has had more than four decades to wait for a new type of mass analyzer with the potential to advance capability over previously applied technology. Almost two years on from the first commercial introduction of Orbitrap GC-MS in 2015, in this presentation, we explore how this technology has been applied specifically to the analysis of environmental contaminants and how the method can be used to support aspects of the Different workflows have been published, proposing ways to cope with the collected amount of data in an automatic, time efficient and reproducible way, which can be applied to samples with various matrices. These workflows in a form of general steps can be summarized as: a) filtering and prioritizing the detected features (peak picking), b) molecular formula assignment, and c) search in one or more compound databases. A relatively young compound database for water relevant compounds is STOFF-IDENT. In order to achieve a comprehensive identification of the water’s organic content, Non-target screening strategies have become increasingly popular. This study was realized by analyzing river water samples with the established RPLC-HILIC-ToF-MS system and by using the STOFF-IDENT compound database. Its main aim is to demonstrate and discuss an efficient strategy for the non-target screening of aqueous environments, as a mean to facilitate the process of identification of very polar compounds. Three 24h composite samples were collected using time proportional samplers; upstream and downstream of a WWTP and wastewater effluent. The samples were analysed by the established
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 to 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/Polyfluoroalkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements
T. Anamal, L. Toelgyesi, T. Sosienski, Agilent Technologies AG, UK

Per/polyfluoroalkyl substances (PFASs) are organic 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 various environmental matrices. Consequently, the USEPA has public health guidelines in drinking water for two PFASs, namely perfluoroheptanoic acid and perfluorooctanoic acid (PFOA) 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 QA/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 (PFSA), 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 (MRM) 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. Several PFASs were detected in sewage water and wastewater from the Saale and Mulde catchments in Germany. These were detected using the R package “nontarget”. Rarity scores were calculated for all detected PFASs and perfluorooctanoic acid water and wastewater samples that were analyzed in the ng/L range. All this was done on a triple quadrupole mass spectrometer that is fully stackable with the HPLC system.

**MO282** Optimisation of solid phase extraction parameters for the isolation and characterisation of benzodiazepines in wastewater
S. Nzube, Cape Peninsula University of Technology / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Somerset, CPUT / Chemistry

Pharmaceutical pollutants entering the aquatic environment have become a growing environmental concern. These pharmaceuticals are unique pollutants because of their special characteristics and behaviour that cannot be simulated with other organic pollutants. The untreated wastewater effluent that contains pharmaceuticals poses a considerable threat to the aquatic ecosystem because of the negative effects of non-target organisms in the water. Recent years have seen a growing concern about the benzodiazepines, as emerging pollutants, and their effects on the aquatic environment. These compounds are nowadays widely detected in sewage wastewater. It is important to increase the emphasis on the characteristics of the benzodiazepines in order to differentiate them from industrial chemical compounds. In this study, various solid phase extraction techniques have been employed focusing on isolation of benzodiazepines in wastewater matrices. Empowering this study, the highly diverse range shown in biological samples from rivers and the detection and analysis of clonazepam and lorezapam as benzodiazepines. Keywords: Benzodiazepines; Emerging pollutants; Solid Phase Extraction; Spectroscopy; Wastewater

**MO283** Monitoring source and drinking waters for Microcystins using online LC/MS/MS method
J. Westrick, Wayne State University / Lumigen Instrument Center; D. Cardona, Thermo Fisher Scientific / Environmental Analysis

In 2015 the USEPA announced an age-dependent drinking water Health Advisory (dWA) for the natural freshwater toxins, microcystins (MCs). For pre-school age children and adults, the MC dWA values are 0.3 mg/L and 1.6 mg/L, respectively. Although the dWA values are non-regulatory values, this announcement compels compelling health information that cannot be ignored. In parallel, EPA Method 544, a solid phase extraction/liquid chromatography tandem mass spectrometry (LC/MS/MS) method was released. Our goal was to create an online concentration LC/MS/MS method with 12 MCs that meets the EPA’s quality assurance/control (QA/QC) criteria. MC concentrations were measured in samples from freshwater lakes and drinking water. Samples were prepared by three freeze/thaw cycles, centrifuging, and filtering through a 0.25 μm polycarbonate filter. Our LC/MS/MS platform included an online sample concentrator with UHPLC for separation and a triple quadrupole mass spec for MS/MS analysis. This method included 12 MCs with retention curves from 0.5 – 500 μg/L with values greater than 0.996. The MCs eluted between 2.2 – 5.2 minutes allowing for the analyses time to be 3) MC-RR, [Asp/][MC- LR, MC-HIr, 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 unknown and truly toxic congeners of MCs need to be monitored. 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 the 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 / Département de Biological Sciences; M. Houde, Environment and Climate Change Canada / Aquatic Contaminants Research Division; S. Baven, 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 / Effect-Directed Analysis

Per/polyfluoroalkyl substances (PFAS) in Drinking Water using LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

**Keywords:** Benzodiazepines; Emerging pollutants; Solid Phase Extraction; Spectroscopy; Wastewater

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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. Schrlau, Oregon State University / Environmental and Molecular Toxicology; S.L. Mosesy Simonov, 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 (OHPAHs) 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 made it possible to identify unknown transformation products 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-, 9-9OH-Phe was achieved with the C18 and phenyl-hexyl columns using a gradient of water (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 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 technological processes. Data available showed that TPs can be more persistent and toxic than their mother compounds. Well-known examples are bromate and NDMA that generate toxic TPs after ozonation. Despite the TPs potentially increased toxicity compared to their parent compounds, transformation processes are not routinely monitored, and in particular those induced by drinking water treatment remain elusive. This lack of information is mainly due to the toxicology challenge. ABA TPs, where no information occurs in low concentrations. Candidate analysis methods are bioassays to assess potential effects or advanced chemical analysis to elucidate TPs, such as non-target high-resolution tandem mass spectrometry (HR MS/MS) methods combined with novel data analysis approaches. Here, we addressed the challenges of TP analysis and the scarcity of TP research concerning studies in drinking water in particular, building on the insights gained from previous work. In a recent project, we assessed the relevance of transformation products as specific for the drinking water sector through interviews with the concerned parties. Based on the sector’s reported needs, we then performed a lab-scale pilot to monitor TP formation of the three organic micropollutants carbanazine, clofibric acid and malathion during the rapid sand filtration and ozonation, two readily applied biotic and abiotic, drinking water treatments, respectively. The experimental results show that degradation of the parent compounds and TP formation are treatment and compound specific. In silico TP prediction and literature mining significantly facilitate TP identification, yet a number of TPs remains structurally unidentified, and for the majority of identified TPs toxicological risk assessment is missing.

MO288
Application of high-resolution mass spectrometry to identifying chlorinated transformation products of aromatic emerging contaminants in wastewater
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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 signals of unknown TPs. We also characterized the transformation of the TPs using database searching and isotope-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 isotope-pattern 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 systemic identification of TPs in real water samples containing multiple ECs.

MO289
Unravelling the potential of a partial nitritation/anammox biomass towards micropollutants biodegradation
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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 micropollutants 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, metoprolol, venlafaxine and carbamazepine). Batch experiments were performed under different biocatalytic conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optional for nitritifying bacteria), iii) aerobic conditions with allylthiourea (an inhibitor of ammonia oxidizing bacteria), iv) anoxic (optional for anammox bacteria), v) aerobic with acetate (optional for heterotrophic bacteria) and vi) anoxic with acetate (optional for heterotrophic denitrifying bacteria). Ibuprofen was the most biodegradable compound, being significantly degraded under all conditions tested except heterotrophic denitrification. Sulfamethoxazole and metoprolol 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, carbamazepine 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 micropollutants.

MO290
Removal of pharmaceuticals in a biofilm reactor: effects of manipulating co-degradation by carbon feeding on system performance
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Pharmaceuticals are frequently detected in pharmaceuticals biodegradation
micropollutants biodegradation
unambiguously. 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 systemic identification of TPs in real water samples containing multiple ECs.

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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, unmetabolized and inoehol removal was attributed to co-metabolism (enhanced acetate). Metoprol, ionomper, diclofenac, propranolol and sulfamethizole removal were reduced 1) at lower acetate concentrations by co-biotransformation dependent degradation 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 considered as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioerator’s performance.

Investigating inhibitory effect of anti-inflammatory pharmaceuticals on activated sludge
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The consumption of pharmaceuticals increase annually due to a variety of reasons including affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropollutants regularly, focusing on priority micropollutants has been performed in the present study. There is a need to develop a reliable analytical methodology in order to determine the potential toxic effects of pharmaceuticals. For this purpose, the aim of this study was to develop a sensitive, selective and reliable method for the determination of 38 selected pharmaceuticals in wastewater samples from the city of Zagreb. The removal rate of opioid analgesics was systematically studied as a secondary effluent from the Central wastewater treatment plant of the city of Zagreb. The experiment showed that ozonation at an ozone dosage of 205 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 main transformation products characterized 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.

Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water
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Potable reuse of wastewater is becoming more common as populations increase and freshwater resources become more scarce. Producing safe drinking water from treated wastewater is challenging due to the presence of contaminants that are not removed or are removed partially by conventional wastewater treatment processes. The transformation products that can be formed with advanced oxidation technologies (AOTs) that are used in potable reuse treatments. These contaminants can be harmful for human and ecological health. In 2013, two Science Advisory panels determined two lists of priority emerging contaminants (ECs) to be monitored in aquatic ecosystems and human potable water reuse. The ECs were determined based on some criteria such as priority, persistence, toxicity, potential health effects and environmental water concentrations. This project is investigating the removal and/or transformation of 21 of these priority ECs through UV-CHI2O, microfiltration and reverse osmosis in three samplings from Full-Scale Advanced Wastewater Treatment Plant (Orange County GWRS) in order to make indirect potable reuse of wastewater safer. Ultra performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS) was used to quantify bisphenol A, p-nonylphenol, bis (2-ethylhexyl)phthalate, butylbenzyl phthalate, perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), diclofenac, ibuprofen, erythromycin, triclosan, 17α-ethinylestradiol, 17β-estradiol, estrone and chlorpyrifos. Gas chromatography mass spectrometry (GC-MS/MS) was used to quantify permethrin, galaxolide (polybrominated diphenyl ether (PBDE)-47), Scyllo-inositol hemi-ether (PBDE)-99, bifenthrin and N-nitrosodimethyl-amine (NDMA). Transformation products (TPs), disinfection-by-products (DBPs), and unknown compounds are being identified via high resolution-time-of-flight GC/QqTOF/MS/MS and UPLC/QqTOF/MS/MS. Some compounds were not removed even after UV treatment. Controlled laboratory chlorination/bromination of priority pollutant compounds were performed in large scale to study the fate of these compounds in drinking water and wastewater disinfection, and many TPs and DBPs were identified, including chlorine- and bromine-containing-by-products. Toxicity studies on these reacted samples were also done, and the results show that many of the TPs are more cytotoxic after being chlorinated/brominated. Mass spectra obtained from these identified TPs and DBPs are being added to a user library for use in determining TPs in our sampled waters.

Elimination of tramadol and methadone in model ozonation experiments: removal kinetics and identification of transformation products
P. KontanjeRjević, Rudjer Boskovic Institute; J. Curko, Faculty of Food Technology and Biotechnology; M. MatoSić, Faculty for Food Technology and Biotechnology; M. Ahel, S. Terzić, Rudjer Boskovic Institute
Since the conventional wastewater treatment has proven to be ineffective for a number of pharmaceuticals, there is a high concern about their ever-increasing release into the aquatic environment. To mitigate this problem, advanced wastewater treatment technologies, such as advanced oxidation and microfiltration, have been proposed as beneficial methods for the removal of micropollutants. In this study, the transformation products were determined using high performance liquid chromatography coupled to tandem mass spectrometry (LC/MS/MS). The mass fragmentation of compounds was studied by fragmentation at positive and negative ion modes. The transformation products (TPs) were identified using the Mass Fragment Finder (MFF) algorithm to identify the most abundant and specific fragments of each compound. The results showed that the transformation products were formed mainly by oxygenation, hydroxylation, and 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 main transformation products characterized 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.

Evaluation of a nano-adsorbent for the removal of metallic carcinogens from wastewater
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South Africa is experiencing the worst drought in recent history, with water becoming a scarce commodity. However, the supply of good quality water is becoming increasingly difficult in view of large scale pollution caused by industrial and domestic activities. Many technologies including coagulation, membrane process, dialysis, foam flotation, osmosis, photocatalytic degradation and biological methods have been employed for the removal of toxic pollutants from water and wastewater. These technologies are effective but have some disadvantages such as expensive equipment, high operational and maintenance, high energy requirements, generation of toxic residual metal sludge and incomplete metal removal. On the other hand, adsorption offers high efficiency, cost-effectiveness, easy handling and recovery of metals and other adsorbed species. Heavy metals are often found in wastewaters and the removal of these inorganic pollutants using bimetallic iron-based nanoparticles is still unclear. In this study, bimetallic iron-silver nanoparticles were chemically synthesized and immobilized with chitosan to form chitosan bimetallic iron-silver nanoparticles (CS/Fe-AgNPs) to remove heavy metals from wastewaters. In this study, chitosan iron-silver nanoparticles beads have been successfully prepared and its efficiency in the removal of Cd(II) under ambient temperatures has been evaluated. The removal
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 very small communities. 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 “Wate R JPI (Joint Programming Initiative, Water)” and aims to provide guidelines for the optimal design of IPR systems. The project FRAME is designed for integration into a decision support system for stakeholders, considering process performance and feasibility assessment for treatment scenarios. Advanced treatment options are applied in a multiple-barrier 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) for environmental impacts. 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 pathogens were developed and a decision support system was developed. 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 and harvesting for drinking water and domestic use. Consequently, it is very important to evaluate the quality of rainwater harvested and stored in these different storage tanks so as to ascertain the impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage facilities commonly used by the general populace in Owerri (Metal drum tank, concrete underground tank, PVC tank and coated basin for rainwater). The physiochemical and microbiological analysis of the 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 value of 160 μg/L. The 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. **Keynote:** Harvested Rainwater, microbiological analysis, physiochemical analysis, storage facilities, trace metals

**MO298**

**Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health**

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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 infant, effluent and sewage sludge (biosolids) are being monitored by GC-MS and LC-MS/MS analysis, tracking the cycle of phthalates throughout the wastewater system. Phthalate biomarkers are being analysed in infant and pregnant milk samples from phthalate exposure 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.
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

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This study proposes to identify the origin of 30 poly- and perfluoroalkyl substances (PFASs), especially non-fluorinated compounds. It is therefore necessary 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, benzenzoilactone, ciprofloxacin and fluconazole. QACs and chlorhexidine were effectively removed by the treatment processes. In addition to the targeted analysis and in order to estimate the proportion of unidentified perfluoralkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Sedlack (2012) was applied to each of the samples. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C₆-C₁₄ PFAs 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 micropollutants such as pharmaceutical residues, ingredients of personal care products and endocrine disrupting compounds in wastewater treatment plants (WWTPs) and receiving waters. In this study, we analysed wastewater samples from the main WWTPs of the city of Rome and contaminant concentrations ranging from ng L⁻¹ to few mg L⁻¹. Among the emerging compounds, antibiotics are of peculiar interests due to their potential adverse effects on aquatic ecosystems diversity and function and because they can act as a potential driver for dissemination of resistance genes. Previous studies show that classes of synthetic antibiotics, such as quinolones, sulfoxamides, tetracyclines, betalacitams and macrolides, widely used in human and veterinary medicine, are rather resistant to microbial degradation, providing an indication as to why these compounds might persist within wastewater treatment plant (WWTP). Nonylphenol ethoxylates (NPEOs), commonly used as detergents, wetting agents, emulsifiers and dispersants, are precursor of nonylphenols (NPs) by the loss of the ethoxy groups. NPs are estrogenic because they can bind to estrogen receptors and can block or alter endogenous estrogenic functions in various reproductive and developmental stages. In fact, NPs have been included in the European list of priority hazardous substances for surface waters in the Water Framework Directive. The aim of the present study was to investigate the occurrence and fate of selected classes of emerging and ED compounds in four WWTPs serving the city of Rome and in the receiving 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.

MO302 Mass flows of antimicrobial compounds in Swedish sewage treatment plants

M. Östman, J. Fick, M. Tysklind, Umea University / Department of Chemistry An antimicrobial biocides are used 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 co- and cross-resistance mechanisms. It is therefore necessary 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, benzenzoilactone, ciprofloxacin and fluconazole. QACs and chlorhexidine were effectively removed by the treatment processes. In addition to the targeted analysis and in order to estimate the proportion of unidentified perfluoralkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Sedlack (2012) was applied to each of the samples. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C₆-C₁₄ PFAs in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFAS molar concentrations.

MO302 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

Herbicides and fungicides are widely used in agriculture to control weeds and fungal diseases that can reduce crop yields. There is potential for these compounds to be transported from treated fields into surface waters via agricultural runoff. 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 water were also collected throughout the POCIS deployment periods. The sampling rates (Rₛ ) for each target compound were 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) using an AB Sciex QTrap flow injection photoionization coupled with an Agilent 1100 HPLC. Among the six herbicide target compounds, the highest maximum concentrations were observed for atrazine (1,070 ng/L), dicamba (845 ng/L) and 2,4-D (691 ng/L). The highest maximum concentrations of fungicides were for oxazosatin (959 ng/L), myclobutanil (86 ng/L) and boscalid (74 ng/L). The rest of the fungicides and herbicides were detected at concentrations below 60 ng/L. There was no correlation between the watersheds that had the highest levels of fungicides vs the highest levels of herbicides. This may reflect differences in crops grown across the region, or differences in the timing of application of the pesticides. Overall, this study indicated that selected current-use fungicides and herbicides are widely distributed at ng/L concentrations in agricultural watersheds in Ontario, Canada.

MO305 A Study on the Distribution and Behavior of Nonylphenol in the Suyeong River, Korea

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Nonylphenol is known, as one of Endocrine Disrupting Chemicals is the degradation product of Nonylphenol ethoxylates being used as nonionic surfactant. Nonylphenol is classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. In order to understand the current contamination and behavioral characteristics of Nonylphenol by measuring the concentration of Nonylphenol in the surface water in the downstream of Suyeong
River of Korea, and based on that, estimating the material balance. During the survey period, the range of Nonylphenol concentration in estuary of Suyeong River had the range of 142.0 – 569.6 ng/L and the average of 271.0 ng/L. The target area was divided into 3 regions to estimate the material balance of Nonylphenol in the downstream of Suyeong River. The dissolved Nonylphenol of 282.3 g/day occurred in region 1 of Suyeong River, and Nonylphenol influx load occurred in particular suspended solids of 12.6 g/day. The dissolved Nonylphenol outflow discharge toward the region 2 was 192.5 g/day, while the adsorption to the particulate suspended solids was 89.8 g/day. In the case of Nonylphenol within the particulate suspended solids, the outflow to the region 2 was 1,250.0 g/day and the amount of settling toward the sediment was estimated to be 422.7 g/day. The adsorption from the dissolved Nonylphenol to the particulate suspended solids in the region 1 and region 2 was 31.8% and 54.9%, respectively. In the region 3, the desorption rate was 8.8%.

MO306 Drugs of abuse distribution in Turia River based on geographic information and ecotoxicological assessment M. Andrés Costas, Univerisdad de Valencia / Environmental and Food Safety Research Group; J. Pascual-Aguilar, V. Andreu, CIDIE CSIC UV GV; Y. Pico, University of Valencia / Medicine Preventive

The aim of this study establishes the influence and the effects of the human pressure in a typical Mediterranean River Basin to determine accurately the point sources of contamination through an environmental forensics methodology. A total of 42 drugs of abuse and a number of the most common N-heterocyclic amines (NDMA) in both natural and urban waters in the Turia River basin of Valencia, Spain. In total, 22 sampling sites were sampled during 2012 and 31 in 2013 along the river. Analysis of the target illicit drugs was performed using solid phase extraction and liquid chromatography coupled mass spectrometry (LC-MS/MS). To determine spatial incidence of drugs of abuse, analytical results of target compounds were geo-referenced and integrated into a geographical information systems (GIS). Ecotoxicological risk assessment was conducted to determine 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.B0006). 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. Avasilić, I.D. Morariu, Grigore T Popa University of Medicine and Pharmacy of Iasi / School of Pharmacy

Nitrosamines can form in water in specific conditions. N-nitrosodimethylamine (NDMA) could be formed during the chlorination of drinking water. 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 nitrosating agent and dichloroacetonitrile via substitution reaction of typical secondary amine precursors; b) catalytic formation of NDMA from the amine-containing activated sludge and soil. 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 activated sludge and soil can be involved in the formation of NDMA. More research is required in order to establish ways to avoid NDMA and other nitrosamines formation.

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 of Spain was not published. Our work represents the first attempt at monitoring these pollutants 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 coastal 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, citalopram and venlafaxine) were present in the collected biota samples (rare, 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 concentration by glyphosate in the AMPF (Fch) was found to be the highest. These findings support the hypothesis that glyphosate has a health risk assessment based on the measured tissue concentrations is underway. Our results confirm the presence of PAs in coastal waters of the Rias Baixas area in concentrations potentially able to cause chronic effects in exposed organisms, as well as the presence of these compounds in biota inhabiting the area. Based on the results obtained further monitoring of venlafaxine and citalopram in coastal waters is recommended, as these results were possible thanks to the Spanish Ministry of Economy and Competitiveness FIS (PI14/00516) and the European Regional Development Fund (ERDF).

M0312
Detection of glyphosate and AMPA in fish bile from the Marne River, France
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Glyphosate is a widely used herbicide. In France, it is used during intercultural operations and to control weeds in non-agricultural areas. Glyphosate 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 glyphosate and AMPA levels in biological tissues and then to determine the contamination of a freshwater fish, the European chub (Squalius cephalus) and the AMPF (Fch) in the Marne River (a tributary of the Seine River situated in the East part of Paris) 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 chub and frozen for further analysis. Then, 100 µL of bile was taken from each sample to evaluate the concentrations of the contaminants in which organisms were added before extraction with milliQ 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 glyphosate is detected in a fish sample coming from the most contaminated site by AMPA. This suggests that glyphosate is assimilated in fish and is still detectable after glyphosate has been degraded to AMPA in the water river. Glyphosate 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 than bile.

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. Otori, D. Barrett, The University of Nottingham / Faculty of Science; T.P. Dedworth, 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. Water is no exception; the current situation brings a surge in the demand of water for drinking, sanitation, municipal, industrial and agricultural uses. At the same time the amount of wastewater generated is unprecedented. Given these facts, it makes sense to look for ways in which to adequately reuse wastewater thereby reducing freshwater demand. One such solution is the reuse of wastewater for agricultural irrigation. Benefits of this practice include the reduction in fertilizer use due to the high nutrient content of wastewater, the environmental benefits of reusing an unwanted resource and the economic advantage for farmers who have to pay little or nothing to use the resource. Furthermore it has been shown that wastewater pollutant load can be reduced as it goes through the environment through processes such as photolysis, biodegradation and adsorption. Using these natural processes to our advantage can reduce the costs of treating wastewater. However it has been shown that treated and untreated wastewater contain emerging pollutants (e.g. pharmaceuticals, personal care products, antibiotics, hormones, etc.). When reusing wastewater for irrigation we are creating a pathway for these pollutants to enter the 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 study 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.

M0314
Psychoactive compounds in mussels: analytical method development and occurrence assessment
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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 control their concentrations in water but also to evaluate if organisms are exposed, given that they are usually expose 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 and safe” (QuEChERS) 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, coccaines, cannabinoids, and hallucinogens) and therapeutic drugs (anxiolytics, antiepileptics, sedative/antihistaminics 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 standards.

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. Jerde, Alfred Wegener Institute / Shelf Sea Ecology; M. Simon, N. van Alst, K.B. Olesen, F. Liu, J. Vollertsen, Aalborg University / Civil Engineering Department Imaging-Micro-Fourier Transform Infrared Spectroscopy (Imaging-µFTIR) applying a Focal Plane Array (FPA) is the most promising analytical tool for direct and rapid analysis of microplastics (MP) deposited on IR windows or collected on suitable membrane filters. The amount of data produced during an imaging analysis (many GB), combined with the lack of specific features addressed to MP identification and quantification, requires commercial FTIR software packages. One of the IR by MPHunter: a new open-source software (MPHunter) for MP analysis which can export, convert and manage datasets from the two EPA-µFTIR Imaging suppliers. The software, which can manage several million single spectra and many...
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. The correlation results can be further refined to define particles. The reference spectra can be easily created and uploaded to the software as a .csv file. The calculation time for comparing 3.2 million spectra to a library of 150 spectra is around 6 hours on a standard laptop. Software features include conversion from %Transmittance to Absorbance and vice versa, selection of multiple customizable spectral ranges/whole spectral range for correlation and filters for residual noise removal. The correlation results can be further refined to define particles. Boundary potential 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 verified by the JPI Oceans project BASEMAN. 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


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 mapping task. This task can be well defined using 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 principle steps to identify microplastic particles by means of FTIR and Raman microscopy. 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 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 using FTIR and the fractions 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. Storslet, L. Sørensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Høyes, Norwegian University of Science and Technology; O. Bråkstad, 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 IR spectra. In this study, we used an automated method for MP classification was developed. Pyrograms with associated mass spectra (m/z range 50-600) were obtained for a range of the most common polymer types, as well as for polyethylene and polystyrene microplastic samples subjected to different types of simulated environmental weathering (UV, additive leaching, abrasion, biodegradation) in the laboratory. An 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.

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 almost exclusively utilised pristine plastic materials that are homogeneous in polymer type, shape, size and composition. This is partly because for microplastics (marine litter < 5mm), as collecting samples of such material from the marine environment in quantities sufficient for use in laboratory impacts 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 (≤5 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) from the coast and sheering comprising ~70% 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 collected material and the generated samples 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, Sn 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 following extraction by ethyl acetate and ultrasonication. A broad
Optimization of the preparation of standards of high density polyethylene microplastics and quantification techniques by stereoscopic and confocal microscopy.

MO323 Microplastics in Expanded Global Table Salt Product Samples and its implication

MO324 Biodegradability of pristine and weathered car tire rubber using different inocula

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A non-complex procedure has been developed for preparing HDPE microplastics as standard for microplastic determination in sediments. Always keeping environmental impact in mind, we prepared microcapsules 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). With this approach, 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 HDPE 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 of microplastics. The standard HDPE 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, 40x 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.

MO323 First Report of Microplastics in Pacific-side Arctic Ocean

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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/m3 in sea ice and 0.34 pieces/m3 in the Arctic polar 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 spot of plastics. 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 sample the analysis 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 relationship to the microplastic contamination between sea-salt and seawater. Significantly, in TED-GC-MS in various worst-case or rather polluted hot-spots (i.e. leaf-compost, soil along frequently used roads). A special emphasis is given to easy and fast working steps and techniques for representative sample amounts. A quantitative assessment of highly occurring MP from littering (standard thermoplastics) as well as tire abrasion (synthetic elastomers) is intended.

MO324 Biodegradability of pristine and weathered car tire rubber using different inocula

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Car tire wear is estimated to represent a major fraction of microplastic pollution in the environment. Rubber particles are transported by wind and road runoff, thereby reaching soils and wastewater treatment systems. Information on their occurrence, fate and degradability in environmental and engineered systems is limited but 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
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 saprotrophs. 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 acetate (100%) while both were unable to be cleaved from their matrix 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 no biodegradation was observed. No induction of rubber on microbial activity was observed. PLGA as positive control in short-term tests is not encouraged due to its limited biodegradability. Future work should consider longer durations, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

Evaluating sorption properties of tire materials using poly-parameter linear free-energy relationships (pplFER)
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Tire materials are common representatives of microplastics in the environment. They are introduced on the one hand as tire wear, an abrasion product, which reaches the environment via road runoff. 1. On the other hand recycled and shredded tire rubber (TCR) is applied as filler material for example on turf fields. 2. It was recently shown that tire materials are a substantial share (66%) on waste that is introduced into the environment as microplastic particles. 3. 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%)). 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 substrates or recycled tire 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 relations (pplFER) 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. 2013. [2] B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo, Sci. Total Environ. 2009, 407, 2183. [3] C. Lauer, 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. 2004, 1037, 29. [8] S. Endo, P. Grathwohl, S. Haderlein, T. Schmidt, Environ Sci Technol. 2009, 43, 3094.

Particle toxicity in the daggerblade grass shrimp (Palaemonetes pugio): microrubized tire wear particles and microplastics
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Recent surveys of Charleston Harbor, SC (USA) have demonstrated that >75% of 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 trace substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHs) and volatile aromatic hydrocarbons (VAPHs), as well as trace metals (notably Zn, Cd) polycyclic aromatic hydrocarbons (PAHs) and volatile aromatic hydrocarbons (VAPHs). Although tire rubber is found in the environment, especially fibers. Therefore little is known about the toxicological 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 exposures, 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 (342672 particles/mL for MR and 3682672 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 suggest that MR exposure has short-term and longer-term toxicity on a key freshwater species.
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. Oberhansli, P. Swarzenski, International Atomic Energy Agency / Radioecology 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 microplastics and nanoplastics 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 radio labeled 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, bioaccumulation and bioavailability of microplastics and their biological 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 in the marine environment under low exposure. 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 plankton community media
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Release of plastics debris in the environment has been catching more and more attention 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 nanoplastics on aquatic organisms without addressing their aggregation state in their biological exposure. This lack is clearly due to the complexity of environmental matrix and the extremely low concentration of nanoplastics, which push towards beyond the classical detection limits of analytical instruments dedicated to their physical characterization. The aim of our work, is to develop unprecedented methods to measure ultra-low concentration of engineered nanoplastics in environmental samples. In a recent study, we investigated aggregation kinetics of plastic nanoparticles in culture media for fresh water (Dauta) and marine (F/2) phytoplankton. Polystyrene nanospheres (20 and 100 nm) and crushed nanoscale plastics particles were added in culture medium at environmental concentration (10⁻⁵⁻⁻¹⁰⁻¹ particle/cm³). Immediately after, evolution of size distribution, fractal dimension and stability were investigated using in situ dynamic light scattering, static and multiangle light scattering, laser induced breakdown detection, asymmetrical flow field-flow fractionation and zeta-meter. Results show a rapid aggregation of nanoparticles during first hours, followed by a slow aggregation until reaching a maximum value after 24 to 48 hours. The different analytical tools used in this study, allowed us to monitor aggregation state and exhibit different aggregation kinetics of plastic nanoparticles, depending on nanoparticle size, form, and salt concentration in order to better characterize the conditions of exposure of phytoplankton by these PS nanoparticles.

MO332
Mytilus spp. as sentinel species for water borne microplastic ingestion; a case study from the Norwegian coast

Mytilus spp. have been investigated as sentinel species for water borne microplastic ingestion; a case study from the Norwegian coast. A total of 252 mussels were investigated from 13 different sites along the Norwegian coast by using KOH digestion followed by visual ID and µFTIR. Occurrence of plastics were found in a total of 76.6% of the analysed mussels from the Norwegian environment, with the overall average plastic load being 1.85 particles gram⁻¹ w.w (ranging from 0 – 24.45) and with the highest values found in mussels from the Barents Sea. Microplastics consisted of fibers (85 %), fragments (15 %) and most particles were 1 mm, with the most dominant polymer group being semi-synthetic materials (rayon/viscose). Based on literature and this current study, Mytilus spp. seems to be a promising sentinel species to monitor pollution of the smallest waterborne microplastics in the marine environment. However, for the method to be fully quantitative, improvements/further investigations are needed e.g. same sized mussels from each site and in different seasons as well as analysis of the plastic matrix within populations. Furthermore, the presence of semi-synthetic materials in the marine environment needs to be further investigated as well as their potential effects on biota.

Mercury Biogeoeciences - Fate, Effects and Policy (P)

MO333
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 separate 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 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 Hg (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 owing to different colonisation depth in the Versoix River (CH). Prior Hg exposure, biofilm biomass and microbial composition (cholorphyll content and abundance of 16S rRNA gene) was determined as well as EPS and thiol composition (anion and cation) of the exposure media were also analysed. Accumulation of total Hg and non-extractable Hg (determined after a cysteine 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 Hg 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 evosional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea
S. Covelli, University of Trieste - 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 not only recognised for its toxicity, mobility and bioaccumulation potential. In coastal areas too, 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 approximatively 800 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 GEM flux measurement cupule (Lumex-RA 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 unimpacted area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these measurements, the background level for the GEM concentration was 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
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In 2013, the Minamata Convention on Mercury was adopted by governments recognizing mercury as a pollutant of global concern for both human health and the environment. After reaching the 50th ratification the convention entered into force on 16 August 2017. According to the Article 22, the Conference of the Parties should establish of arrangements for providing itself with comparable monitoring data on the presence and movement of mercury in the environment as well as trends in levels of mercury and mercury compounds observed in biotic media and vulnerable populations on the basis of available scientific, environmental, technical, financial and economic information. UN Environment in close collaboration with Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IAI) and WHO implemented a UN Environment - Global Environmental Facility (GEP) 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 analysis 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-Mercury)”.

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. Monieux, Université de Genève; G. Daffe, University of Bordeaux / UMR EPOC CNRS 5805; A. Boulemant, RioTinto, 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 and to estimate the capacity for mercury analyses in humans 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-Mercury)”.

MO337
Mercury Photo-reduction and Total Photo reducible Mercury Dynamics in the Lakes of Keijmijk National Park, Nova Scotia
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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 carbohydrate ligands, 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 proof-of-concept group over the last few years with total reducible mercury as well as constant 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 Keijmijk National Park, Nova Scotia, Canada. We examined the hypothesis that gross photoreduction and photoreduction rates would be significantly different in lake water. Another hypothesis was that the amount of mercury available for reaction with solar radation (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 reduction rates by difference). The results 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 photooxidation 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. Kickbusch, Acadia University / Biology; M.L. Mallory, Acadia University / Biology; J. Christopher, 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 freshwater ecosystems. 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 carbohydrate ligands, 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 proof-of-concept group over the last few years with total reducible mercury as well as constant 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 Keijmijk National Park, Nova Scotia, Canada. We examined the hypothesis that gross photoreduction and photoreduction rates would be significantly different in lake water. Another hypothesis was that the amount of mercury available for reaction with solar radation (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 reduction rates by difference). The results 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 photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

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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, Minorca 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 not been compared. Except for HeCB, the values were higher in the upper trophic level with statistically significant differences for ΣDDTs and ΣPCBs (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=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 ΣDDTs, ΣPCBs 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 accepted value of 2.0 µg/kg bw. This showed that the equivalent daily intakes for MeHg, involving provisional tolerable weekly intake of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intake in adults and children (7-12 years of age), respectively. Mercury, Commercial Fish & Risk assessment: a Review study (1994-2015) H. Coelho Vieira, University of Aveiro; J. Von Osten, Autonomous University of Campeche / Instituto EPOMEX; A.M. Soares, F. Morgado, University of Aveiro / department of Biology & CESAM; S. Abreu, University of Aveiro / Dep. Biology & CESAM Fish consumption is linked to the prevention of some human diseases, especially reduction in cardiovascular diseases and some neurological 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 (Rd) as recommendations to Hg intake. Some studies have been finding 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 fish 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 (SMECA) and market surveys. At the Azores, more than 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 Mora moro 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. Mercury concentrations in black in the Gippsland Lakes, Victoria, Australia. L. Meier, EPA Victoria / EPA Victoria; S. Balshaw, Department of Health and Human Services; R. Goudy, EPA Victoria The Gippsland Lakes are a coastal lakes system in eastern Victoria, Australia. They represent a unique aquatic 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 bushfires and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black in back 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 mercury in black in the back from the Lakes that has been documented 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 bushfires and planned burns.
industrial, agricultural and harbor activities, which impact the environment through the release of contaminants such as metals. Among these metals, mercury (Hg) is highlighted due to its toxicity and capacity of biomagnification. In the Paranaguá estuary, in the state of Paraná, and in the Cananéia estuary, state of São Paulo, these potentially polluting activities are present in different levels. However, these regions comprise the largest remnants of the Atlantic Rainforest ecosystem, fact that gives them the status of World Heritage site and biodiversity hot spot (UNESCO), therefore a environmental monitoring and conservation acts of the areas are necessary. Thus, this study investigated the concentrations of Hg and nitrogen isotope ratio (δ15N) in the trophic web composed by benthic invertebrates, benthivores fish (Stellifer rastrifer, Paralichthys brasilensis and Isopisthus parvipes) and marine mammals (Sotalia guianensis and Pontoporia blainvili), 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 Paranaguá and from 7.1 to 14.3 % in Cananéia, with continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaguá (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 Paranaguá, but they were not significant, which indicates a trend of biomagnification of this element. Such a behavior is expected since input sequences from anthropic activities than Cananéia, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

**MO344 Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada**

M. Arzadon, E. Yumvhoze, A.J. Poulan, J.M. Blais, University of Ottawa / Biology

Mercury (Hg) is a global pollutant that bioaccumulates in aquatic and terrestrial foodwebs as monomethylmercury (MMHg). Biological activity is the main driver of Hg bioaccumulation, with sulfate reducing bacteria being a major contributor. The roasting of arsenopyrite at Giant Mine in Yellowknife, NWT, has created strong environmental gradients of sulfate in lakes surrounding the area with distance from the mine. Whereas total Hg levels remain constant with increasing distance from the mine, total Hg concentrations relative to the trophic level to the stock. We hypothesized that high sulfatic in lakes near the mine may be responsible for elevated MMHg concentrations in those same areas. To test our hypothesis, we sampled water and sediments from lakes spanning a range of distances from the Giant Mine. We determine simultaneous methylation and demethylation rates using stable isotope analysis and characterized the microbial community structure using high throughput sequencing of 16S rRNA genes. By analyzing methylmercury production and microbial community composition, we have identified sulfate as being the main driver of both final concentrations of methylmercury and microbial community structure.

**MO345 Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish**

V.F. Barbosa, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seafood Upgrading; P. Anacelo, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seafood Upgrading; R. Alves, King Abdullah University of Science and Technology (KAUST); A. Maulvaut, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seafood Upgrading.; F. Fogaça, Embrapa; T. Langerholc, Faculty of Agriculture and Life Sciences, University of Maribor; A. Marques, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Upgrading

Human exposure to mercury (Hg) and methylmercury (MeHg) increases in diets rich in high trophic level marine species, resulting in health related concerns through food chain. Nevertheless, the overall concentration of Hg and MeHg detected in seafood does not always reflect the amount that will be available for absorption by human intestinal epithelium after the digestion process. On the other hand, several studies have highlighted the health benefits attributed to green tea consumption and their potential effects on reduction of bioaccessibility of contaminants. In this context, the aim of the present study was to assess the effect of green tea in Hg and MeHg bioaccessibility in raw and cooked marine fish species. Results demonstrated that total Hg and MeHg concentration in seafood does not reflect the bioaccessible fraction. Hg bioaccessibility in raw samples ranged between 60% (yellowfin tuna and black scabbardfish) and 37 % (European congri), with most species presenting a bioaccessibility below 50%. Moreover, after grilling, Hg/MeHg bioaccessibility significantly decreased in all species, ranging between 31% (yellowfin tuna) and 8% (Atlantic wrecksill). The bioaccessibility of Hg and MeHg was also affected by the presence of green tea, decreasing the amount of these contaminants. In raw samples with tea, Hg bioaccessibility ranged between 47% (black scabbardfish) and 26% (swordfish); and between 18% (yellowfin tuna) and 7% (swordfish) after grilling. Green tea significantly decreased Hg/MeHg bioaccessibility in raw samples of yellowfin tuna, common smooth-hound and swordfish, as well as in grilled yellowfin tuna, common smooth-hound, atlantic wrecksill and blue shark. Bioaccessibility variability may be explained by changes in the chemical composition of species during grilling and green tea catechins bioavailability, once they are relatively unstable. This work clearly reveals that green tea is able to reduce Hg and MeHg bioaccessibility, leading to lower the risks associated with seafood consumption. Nevertheless, a better understanding of green tea bioaccessibility is needed, and how its protective effect affects other contaminants. Such information is certainly useful to help consumers to wisely select their food, and to enable food safety authorities to integrate this information in risk assessment and communication activities.

**MO346 Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment (northern Adriatic Sea)**

E. Petranich, University of Trieste / Dept. of Mathematics & Geosciences; L. Terrinelli, University of Trieste; S. Covelli, Dipartimento di Matematica e Geoscience / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; E. Pavoni, University of Trieste

Saltmarshes are important constituents of marine-coastal transitional environments that provide several services to the ecosystem. Due to anthropogenic activities, several contaminants are increasingly introduced into these environments where they may accumulate and bioaccumulate from anthropic activities than Cananéia, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

**MO347 Main sources of mercury releases in Armenia**

A. Aleksanyan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Noospheric Studies NAS RA; G. Tepanosyan, Center for Ecological-Noospheric Studies NAS RA / Environmental geochemistry department

National mercury releases inventory was done with the use of UNEP’s "Toolkit for identification and quantification of mercury releases (January 2015)". The following main sources of mercury releases in the Republic of Armenia were identified: - Coal combustion and other coal use - Combustion of other types natural fuels (petrol, kerosene, diesel, liquid petroleum gas) - Natural gas - Zinc concentrate production - Copper concentrate production - Black copper converter production - Pig iron production - Parameters highlighted a tendency, for metal to be exported from the TF-system due to the tidal flows in ebb tide conditions. The results obtained for the PHg fluxes, in particular, are in agreement with those observed on a macro-scale at one of the lagoon tidal inlets considering an annual mass-balance of PHg performed via several water column sampling campaigns. A simple estimation provides a negative sedimentary budget for the TF-system, which lower PHg towards the lagoon channel during the tidal semi and full tides. Confirming other evidence of serious morphological deterioration of this coastal transitional environment. Keywords: tidal flat-saltmarsh system, mercury, tidal fluxes, sedimentary budget.

**MO348 Spatial and temporal variation of mercury accumulation in Thylustra**

A. Aleksandryan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Noospheric Studies NAS RA; G. Tepanosyan, Center for Ecological-Noospheric Studies NAS RA / Environmental geochemistry department

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hispindula in the upper Felidia river basin, Colombia
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The upper basin of the Felidia River, located in the Paralones National Park of Cali, Colombia, is subject to different anthropogenic stressors, such as tourism, the product of illegal mining. Using a direct quantification method (EPA 7473), it was studied the variation of total mercury (HgT) in specimens of the riparian fern Thelypteris hispinula, sediments and water in three streams: El Socorro, El Rato 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 concentrations in the water, while in the sediment there was a spatial level in each studied matrix (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 (r = 0.918, p = 0.000) and leaves (r = 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 (r = 0.764, p = 0.001). These results demonstrate the environmental effects caused by mining activities in protected areas in Colombia.

M0349
Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Déulé River, northern France
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Due to several metallurgical plants along the river, the Déulé 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 Déulé River, in the city of Auby, 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 metals concentrations in the water (Cd, Pb, Zn: 3 to 34 mg/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 months of the experiment. Both AC and BC treatments however, reduced 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 caused 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 mg/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.

M0351
Bayesian Human Health Risk Assessment of Almaden Mining Area
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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 environment (via ingestion of food) and activity (consumption of fish) could be related. Using the Waste Incineration Directive 2000/76/EC and the Minamata Convention on Mercury entered into force on 16 August 2017. As Minamata Convention includes a ban on new mercury mines, this methodology could be used to establish if mercury contamination after mercury mines closure become worldwide human health risk. E-mail contact: david.bolonio@upm.es, https://orcid.org/0000-0002-9166-1861

M0352
Concentrations of mercury in two offshore skates: sandy ray and shagreen ray
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Concentrations of mercury in two offshore skates: sandy ray and shagreen ray. Concentrations of mercury in muscle and liver tissues from two offshore species of skate were examined. Concentrations of mercury in muscle of Leucoraja circularis (n = 9, 10.5–17 cm total length, 157–490 m water depth) and L. vulpinca (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.

M0353
EMPIR project "MereOxo - Metrology for oxidised mercury"
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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 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 Gunnekleiv fjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations. Both were low in dissolved Hg (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. Additionally, THg and MeHg concentrations in sediments measured by DGTs with an aragonite diffusion gel and a spheroid-thin resin gel. Pore water data show a net production of MeHg in the GF control, from an initial 8.7 to 393 ng/ml within the first month, but it then drops off to 147 and 18.4 ng/ml after 3 and 6 months respectively. Compared to the control, the initial reduction of 86% MeHg in pore water is seen for the BC treatment, that increases to >95% for the 1, 3, and 6 month time series. The BC treatment caused 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 mg/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.
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 methodological 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 needed to solve the traceability problem that currently exists in the measurement of total mercury (Hg(0)) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg and for accurately comparing the Hg(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 model was used 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

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Waterborne and dietborne exposures of freshwater fish to inorganinc mercury (Hg(0)) affect their growth and reproduction. However, a mechanistic model to predict the impact of Hg(0) 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 body weight. The effects of biotic and physicochemical 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⁻¹ ww. In contrast, musclarad had the lowest internal exposure doses of 0.0001 – 0.0003 μg g⁻¹ ww (Hg(II)), indicating that Hg(II) accumulation in muscle would be of concern in cases below the 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⁻¹ ww, respectively. A parameter Hill model was used to predict the chronic Hg accumulation in fish that are deemed safe for human consumption.

MO355

Mercury in fish, fish intake and fish consumption recommendations

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Fish consumption is recognized as an important component in the human diet, due to the high-quality protein content and n-3 fatty acids, however, it is also considered the main route of mercury (Hg) exposure from ingestion of contaminated seafood. Hg is released into the environment by natural and anthropogenic sources and recognized as a pollutant of high importance, due its high degree of toxicity, persistence and bioaccumulative properties. Since exposure to mercury poses human health at risk, the Food and Agriculture Organization (FAO)/World Health Organization (WHO), Joint Expert Committee on Food Additives (JECFA) and also by the United States Environmental Protection Agency (USEPA) have been established reference doses (RfD) or “Provisional Tolerable Weekly Intake” (PTWI), in order to minimize that risks. JECFA established a PTWI for MeHg of 1.6 μg kg⁻¹ bw⁻¹ week⁻¹, whereas USEPA pointed a lower value of MeHg intake, setting the RfD at 0.13 μg kg⁻¹ bw⁻¹ day⁻¹ (equivalent to 0.79 μg kg⁻¹ bw⁻¹ week⁻¹).

Recently (2012), PTWI suggested by JECFA for MeHg was revised by the European Food Safety Authority (EFSA) to 1.3 μg MeHg kg⁻¹ bw⁻¹ week⁻¹. This study, presents a brief review of the Hg concentration present in the muscle of commercially valuable fish species caught near the mid-Atlantic ridge (Azores Archipelago) where fish consumption is relatively high (….) and compares these Hg concentrations with the maximum levels of Hg for certain contaminants in foods established by the European community, evaluates the human exposure to Hg, using the Hg concentration quantified in scalp hair and related with fish consumption using a food frequency questionnaire and establishes isocurves pointing the maximum number of fishmeal per week without exceeding the MeHg RfD (USEPA RfD), by combining number of meals (per week), amount of fish 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 227g; only fish with MeHg concentrations below 0.34 μg g⁻¹ could be selected to be consumed so that the PTWI established by JECFA would not be exceeded, despite the concentration of 0.5 μg g⁻¹ (for most of the fish species) or the concentration of 1.0 μg g⁻¹ ("exception list") is allowed for fish consumption.

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

MO356

Ring-test of different implementations of the General Unified Threshold Model of Survival (GUTS)

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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), 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 scenarios with realistic mortality rates. The authors suggest that 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 errors of source 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

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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 results from standard studies to the desired species for untested ecological 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. Many DEB theory-based models 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 their feeding adaptations, fish do not change their metabolism 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 account for different feeding adaptations. We suggest that the model adaptations needed in such case, 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.

MO358
TK-TD modelling as additional line of evidence in the risk assessment for aquatic macrophytes exposed to chlorotoluron as a case study
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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 cover all possible growing 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 light availability and temperature, using different temperature and 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 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 predictions 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 characterized 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 Margin of Safety was above 20 all analysed scenarios. The experimental results obtained for the various exposure scenarios are in good agreement with 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.

MO359
TK/TD modelling as a tiered approach to reveal interspecies variability of toxicity in fish
F. Gabisi, RIFCON GmbH; T. Prest, Bayer AG / Environmental Safety
Species sensitivity distribution (SSD) analysis can be used in higher tier risk assessment to describe the variation in sensitivity of a group of species to a certain contaminant. Contrary to the standard procedure in which toxicity endpoints are derived by considering only effects at the end of a constant exposure experiment, this method has the potential to additionally make use of time-variable exposure and organism response over time. Here, changes in SSD (and the corresponding HC50 values) over the scenario window were investigated for 50 species using the toxicokinetic/toxicodynamic (TK/TD) model for survival GUTS. The GUTS model was parametrized based on standard acute tests for each fish species and both stochastic death (GUTS-SD) and individual tolerance (GUTS-IT) assumptions were tested. Then, the 58-day LC50 for constant exposure and for two different pulse exposure scenarios (single and double pulses) were derived. The LC50 values were subsequently used as inputs for the SSD calculations. The SSDs were derived by fitting probability distributions to the LC50 data, and the corresponding HC50s were determined. The analysis was performed separately for two compounds. Results with both toxicants revealed that the sensitivity ranking for the fish species and consequently the HC50 values were not the same among the tested exposure scenarios. Predictions with either GUTS-SD or GUTS-IT models also had an impact on the SSDs and did not yield the same results for the same exposure profile. Additionally, longer exposure durations did not always result in lower HC50s. These findings infer that SSD strongly depends on the exposure scenario, and reveal the interference of substance toxicokinetics and organism responses to toxicity in determining the sensitivity ranking of the species. Therefore, it is essential for a reliable environmental risk assessment not only to consider realistic exposure scenarios, but also the TK/TD processes related to the substance and the organism. With a set of standard data, the GUTS model can help to achieve this goal for untested exposure patterns.

MO360
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. Our 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 functionalities of EasyGUTS 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. Brand, 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 presumption. Particularly in chronic studies, test organisms are continuously 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 biologies - 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 GUTS 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. Gerbs, Bayer AG / Crop Science Division / Department of Environmental, Social and Spatial Change

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SETAC Europe 28th Annual Meeting Abstract Book
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 tests 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. Applicability of toxicity endpoints, such as the LC50s, have been reported to depend on ambient temperatures and temperatures in aquaculture environments and 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 temperature regimes. We use GUTS to extrapolate toxic effects across temperatures and investigate the impact of temperature on a species sensitivity distribution (SSD) with aquatic invertebrates regarding Chlorpyrifos.

MO363 Lemma toxicokinetic and toxicodynamic (TK/TD) modelling - Impact of the ecological scenario on the risk assessment
S. Heine, Bayer Ag / Effect modelling; E. Brun, Bayer AG, Division Bayer CropScience / Ecotoxicology; 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) uses TK/TD population models for aquatic organisms in field surface waters, states TK/TD population modelling as an approach for the aquatic risk assessment. Although, the EFSA aquatic guidance states TK/TD population modelling as a method for the toxic risk assessment, there is a lack of guidance’s and practical experiences for this new technique – especially to what extent the environmental scenario in which a TK/TD population model is applied influences the outcomes in aquatic risk assessment. Unfortunately, it is not obvious which environmental scenario is a conservative one, e.g. a high or a low level of nutrient or temperature. In this contribution, we analysed the sensitivity of a Lemma model (Schmitt et al., 2015) to changes in environmental conditions in a risk assessment case study. For this case study we considered exposure to a toxicant and conducted several simulations with the Lemma model. While the exposure situation was kept equal in all simulations, the environmental conditions were changed. Results demonstrate that population dynamics are altered the most in cases where the exposure occurred in phases with strong growth of Lemma. This analysis can be the basis to set a conservative ecological scenario for environmental risk assessment for Lemma TK/TD modelling approaches.

MO364 Defining ecological lake scenarios for population modelling as part of the Ecological Risk Assessment of chemicals
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The ecological risk assessment of chemicals (ERA) aims to minimize adverse ecological effects on populations and ecosystems. This assessment strongly depends on the selection of appropriate 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 biocenotic 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. lowrophic, eutrophic) and shallow water bodies as for other standardised ecological scenarios 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.

MO365 The use of population models in copper risk assessment: a case study with Alchimener transmontanus
K. Vlaeminck, Arche consulting / GhEnToxLab; K. Vlaeminck, GhEnToxLab; P. Van Sprang, ARCHE; K. De Schamphelaere, Ghent University / UGenT / Applied Ecology and Environmental Biology
Current metal risk management consists of assessing single-species data on metal toxicokinetics and constructing species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDDs 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 (Acipenser 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 NetLog. Copper effects were integrated by adjusting the mortality rate for the sensitive life stage (age-0 individuals) for different scenarios (e.g. 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. However, 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.

MO366 Comparison of toxic effects on Daphnia magna between a metal, a pesticide, and a PAH, in a toxicokinetic-toxicodynamic framework
K. Vlaeminck, Arche consulting / GhEnToxLab; K. Vlaeminck, GhEnToxLab; P. Van Sprang, ARCHE; K. De Schamphelaere, Ghent University / UGenT / Applied Ecology and Environmental Biology
Modelling techniques are becoming more prominent in the risk assessment of chemicals. Mechanistic models, such as individual-based models (IBM) with a foundation in the dynamic energy budget (DEB) theory, are increasingly promoted as alternative tools in ecological risk assessment. In this context, lethal toxicokinetic-toxicodynamic (TKTD) models are often used to describe (sub-)lethal effects on the life cycle of the modelled organism. Inherently, the mode of action will differ between compounds (i.e. compounds will affect different physiological processes). The current study compares TKTD parameters of three different compounds, and examines their influence on the dynamic energy budget (DEB) model of Daphnia magna. For this purpose, the TKTD parameters were estimated for copper, endosulfan, and a polycyclic aromatic hydrocarbon (pyrene). The TKTD model was calibrated for each compound based on life cycle experiments with Daphnia magna-effects of the three compounds. During life cycle experiments (21-days), growth, reproduction and survival were monitored at different concentrations for each of the compounds. Using all three endpoints, the modes of actions and the TKTD parameters were estimated for copper, endosulfan, and pyrene. Combining the TKTD model with DEB-IBM, effects on physiological processes can be translated to the organism level.

MO367 Estimating predicted no-effect concentrations for perfluoroalkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model
A. Gredelj, A. Barausse, L. Grechi, L. Palmeri, University of Padua / Department of Industrial Engineering
Health and environmental risks posed by perfluoroalkyl acids (PFAAs) have been raised due to their ubiquitous occurrence through various industrial processes and their environmental persistence. One of the most critical environmental issues related to PFAAs is their transport in aquatic ecosystems, especially for the Northern Italy, because of its high industrialization and population. Nevertheless, the real risk connected to PFAAs as emerging contaminants, both for ecosystems and for human health, is still somewhat unexplored. Linking external exposure to the effective dose of the chemical is one of the main tasks of Environmental Risk Assessment. For this purpose, the establishment of safe ecological thresholds such as Predicted No-Effect Concentration (PNEC), based on procedures incorporated in the REACH regulation and Water Framework Directive and in related guidelines. These policies offer three methodologies for deriving PNEC: use of assessment factors (AF), species
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 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 evaluate the potential 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. Chua, 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, Washington State University / Institute of Environmental Toxicology; K. von Stackelberg, NEK Associates LTD / Department of Environmental Health Population viability analysis is useful tool 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-RRM links concentration of OPs to % Acetylcholinesterase (AChE) inhibition which is then linked to sublethal impacts that are incorporated into 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 preliminary results of this model development suggest that environmentally realistic concentrations of OPs may slow the growth of salmon populations, undermining the success of current restoration efforts.

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, URAPPA-INRA / URAFPA INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAPPA INRA; M. DELANNOY, URAPPA-INRA / URAFPA INRA; A. El Hajj, T. Oster, C. Malaplate, Université de Lorraine UL / URAPPA INRA; N. Tran, Université de Lorraine UL / École de chirurgie, Faculté de Médecine de Nancy, F. Yen-Potin, C. Feidi, Université de Lorraine UL / URAPPA 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 clear understanding between exposure and disease can often be 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 cloretocone (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 using 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, CEHTRA 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). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Eenoch 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 crucially 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. Boßmann, Aarhus University / Environmental Science; D. Fernández-Calviño, K.K. Brändt, 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, algicides 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 ($T_{1/2} < 10$ d) to compounds with higher persistence ($T_{1/2} > 120$ d). For two selected biocides (terbutryn and octylisothiazolinone) a set of structural alerts associated with specific MechoAs was developed (Bauer et al. 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Eenoch 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 crucially 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)
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)urban 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 facade 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. Borth, 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 facade coatings to protect the materials against biological deterioration. In-can as well as film 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 biocides and photoproducts were investigated. The latter is based on a (sub)urban Emission Scenario (ESD) for Rodenticides (2003) has been reviewed to evaluate the phototransformation rates and pathways of the biocide transformation 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 phototransformation of biocides. First, pigments are shielding 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 pattern with different pigments. The loss rate of the paint 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. Petersohn, German Environment Agency (UBA) / Section Biocides; K. Wege, A. Friesen, German Environment Agency UBA; M. Amthe, S. Hattel, 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. The latter is based on an Emission 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 into the western 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. Michaelis, 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 a revision 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 cycles 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 minimize 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 each 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. Ghikere, Arche consulting; F. Verdonck, ARCHE; T. De Wilde, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; E. Van Ael, A. Ghikere, Arche consulting; F. Verdonck, ARCHE; T. De Wilde, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation

Under the Biocidal Products Regulation, applicants can apply for authorisation of biocidal product families (BPFs), 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 similar uses, the same active substances to aquifers and 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.

First 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.
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 risk assessment for a BPF of disinfectants (PT 1-5). Risk assessments can be grouped (a) for different products/uses within a meta 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 its metabolites for the aquatic compartment
D. Hernandez-Moreno, INIA / Environment; M. Blazquez, INKOA SISTEMAS / RTD; O. Andreu-Sánchez, Xenobiotics; A. Bermejo-Nogales, M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment
The EFOPS-COMBASE 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, target species, and aquatic chronic toxicity data for fish, 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 LC50 as: 1 (≤ 1 mg/L), 2 (>1 to ≤ 10 mg/L), 3 (>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, marine organisms being the least studied. There was not reported data for around 30% 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 25% 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 (< 1%) 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.
Acknowledgments: EFOPS-COMBASE project (LIFE15 ENV/ES/000416)

MO380 Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015
M. Sánchez, INIA / Environment; L. Ortega, Centre for Coastal and Marine Research (NIVa) / Centre for Coastal and Marine Research; T. Stenersen, Norwegian Institute for Water Research NIVA / Marine Biology; B. Aaslyng, E. Øvrevold, Norwegian Institute for Water Research NIVA / marine pollution; D. Hjermann, Norwegian Institute for Water Research NIVA / Oceanography; J. Beyer, N.W. Green, NIVA Norwegian Institute for Water Research NIVA / marine pollution
Imposex is TBT-induced malformation of male sex-characters in female dogwhelk (Nucella lapillus). This biological effect is quantified by the Van Deeren Seference 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 organo tin compounds (TPTN). The following conversion factors (3.3 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 Karmsundet, 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 algaeicides under BPR**

C. Durou, M. Darriet, 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- 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 associated with reuse or re-introduction. Plant growth inhibition is the most important environmental risk in the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several active 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 algaeicide applied in swimming pools. The poster will be based on following key aspects: 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 the characterisation of the risks posed by the active substance to discuss possible options to refine the exposure of 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 Ltd.

The tiered chemical risk assessment framework adopted in Europe for evaluating 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 exposure scenarios for livestock. In the case of biocidal products, only 42 are approved in the EU. The spatial distribution of the biocides can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk associated with reuse or re-introduction. Plant growth inhibition is the most important environmental risk in the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water. Several active 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 algaeicide applied in swimming pools. The poster will be based on following key aspects: to determine an effective in-use concentration which is an input parameter for assessing the risks posed by the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for the characterisation of the risks posed by the active substance to discuss possible options to refine the exposure of including new studies and risk management measures.

**MO385**

**Comparing methods for estimating environmental emissions**


The environmental risk assessments consist of information on exposure and hazards of chemicals to environmental compartments. Environmental emissions estimated for biocidal products are estimated according to Emission Scenario Documents (e.g. OECD ). In some ESDs, the emission is calculated based on the use/consumption of the product as specified on the label (e.g. PT18), with a number of default assumptions applied. However, other ESDs include the facility to take account of tonnage information as well as average consumption values in product specific calculation models (e.g. PT2). Both approaches have strengths and weaknesses. However, the importance of establishing realistic and reliable methods of estimating environmental emissions cannot be understated, especially in light of the intention to develop guidance on aggregate assessment. Accordingly, this poster will illustrate on two approaches for estimating emissions: regional tonnage (top down) or consumption (bottom up). Opportunities and limitations of the applicability of the data and their implications for use in EU environmental exposure assessments will be evaluated.
MO387 Recommendation on Steam Cracker allocation for the sake of comparability of petrochemical products datasets used in LCA studies

G. Castelán, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different market products, like ethylene, propylene, benzene, toluene, xylenes. 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 consensual 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 products 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

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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 A-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 datasets may have followed this approach, the results have different sensitivity to uncertainties in the allocation process. Further, bias in uncertainties and a better uncertainty values are significant 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 error 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

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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’ 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 nanomaterial-based adsorbents, but they are compared without considering the applications. Another study by Baumann et al. considers 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 three European countries. On the basis of these 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. Bahrampour, 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 nanomaterial-based 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 FeO3-based (Fe2O3@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, characterisation results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of the produced adsorbents, it is also associated with a significant enhancement of negative environmental impacts. A "what-if" perspective was applied to assess the uncertainties of using lab-scale data for parameters including amounts of acid (HCl + H2SO4), ammonia, ethanol, methanol, DCC (N,N'-dicyclohexylcarbodimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of the test comparing the impacts between MGO-NH-SH and FeO3@SiO2-NH-SH estimated respectively 37, 34, 40, 31, and 26% more climate change, in addition to energy use, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis were 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

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SETAC Europe 28th Annual Meeting Abstract Book
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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 results of LCA, the variability in consumer behaviour is generally ignored in LCAs, which use the average behavior 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 household cleaning products. The data for 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 country 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.

M0394 Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments

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Nanomaterials (NM) will enter the environment via diverse pathways. Sewage sludge for example is repeatedly applied as fertilizer on farmland due to its high nutrient content. This may lead to a significant increase in environmental issues and support decision makers, our project aims to elucidate specific emissions factors for ammonia and nitrous oxide that can be included in regional life cycle assessment studies for WOSR cultivation. Thus, field experiments were conducted to increase the data basis and subsequently derive WOSP-specific emission factors. Furthermore, the project strives to develop robust but also generalisable statements about nitrous oxide emissions and ammonia volatilisation due to returning digestate from biogas plants to the field using state-of-the-art application methods. The enviroplausibility and environmental sustainability of trade-offs in the environmental assessment of WOSR production including additional aspects such as fertiliser use efficiency.

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

M0395

Site-specific N-emissions of rapeseed cultivation in Germany

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Globally growing population increases the demand for food, which should be produced as efficiently but also environmentally friendly as possible. Simultaneously climate change requires the reduction of greenhouse gases (GHG) in order to keep the global temperature increase below 2°C. Germany has defined ambitious goals to reduce its GHG-emissions. The reduction targets are 40% by 2020, 55% by 2030, 70% by 2040 and 80%-95% by 2050. Within the last 15 years, GHG emissions from agriculture have not decreased. Simultaneously the European Water Framework Directive requires a good status of water bodies, which is in particular regions in Germany not achieved. Winter oilseed rape (Brassica napus L., WOSR) is the major oil crop cultivated in Germany. Nitrogen field emissions are usually estimated using IPCC-emission factors that are not specific for the crop and associated with strong uncertainty. N2O field emissions are controlled by N fertilization and dominate the GHG balance of WOSR cropping due to the high global warming potential of N2O. The same applies for nitrate emissions that dominate the Eutrophication potential or ammonia emissions for the Acidification potential of WOSP when organic nitrogen fertiliser is applied. To address these issues and support decision makers, our project aims to elucidate specific emissions factors for ammonia and nitrous oxide that can be included in regional life cycle assessment studies for WOSR cultivation. Thus, field experiments were conducted to increase the data basis and subsequently derive WOSP-specific emission factors. Furthermore, the project strives to develop robust but also generalisable statements about nitrous oxide emissions and ammonia volatilisation due to returning digestate from biogas plants to the field using state-of-the-art application methods. The enviroplausibility and environmental sustainability of trade-offs in the environmental assessment of WOSR production including additional aspects such as fertiliser use efficiency.

The environment as a reactor determining fate and toxicity of nanomaterials (P)
The test materials NM-300K, previously sulfidized NM-300K, a nanoparticulate Ag-NPs, and bulk Ag-NPs were added with an influent concentration of 1 mg/L and AgNO₃ 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, 120 and 180 days, the bacterial activity (Avena sativa) and the substance induced respiration (SIR, OECD 217) were observed. In addition, after 60 days of aging of the AGNM in the test soil a sub-sample was taken from each treatment and a chronic plant test was carried out (Avena sativa) and both the roots and the shoots were examined for an uptake of the Ag. We found an increasing inhibition of the ammonia oxidizing bacteria (AOB) from day 60 until day 180. The inhibition of AOB was dependent on the intensity of the silver nitrate (70% inhibition) and the nanosized Ag-NPs (30% inhibition). There were no effects on the emergence or plant growth of Avena sativa over 8 weeks in the chronic plant test. An uptake of a low Ag concentration into the roots of the plants was observed.

MO398 Energy reserves and respiration rate in the earthworm Eisenia fetida after exposure to zinc in nanoparticle or ionic forms
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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 earthworms Tiron Eisenia fetida and T. fetida are discussed. This study was supported by the National Science Centre, Poland (2015/17/N/NZ8/01576).

MO399 Evaluating the Cellular & Humoral Immune Responses of the Terrestrial Isopod, Porcellio scaber, to Gold Nanoparticles
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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 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 immune system of 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 threat, studying it in conjunction with traditionally used parameters of toxicology can give more information into the possible effects these particles may have. This current study used two types of gold NPs and a single mixture of the two 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 measured by measuring the activity of the phenoloxidase, which is an enzyme that can give more information into the possible effects these particles may have. This study was supported by the National Science Centre, Poland (2015/17/N/NZ8/01576).
and light conditions. Thus differences in the toxic effects of the pristine materials were established, although their ranking was not conserved between the species. Studies with chemically transformed or environmentally aged nanomaterials are currently under way to assess whether these differences persist as the silver nanoparticles are sulfdidised and the polystyrene/ITO nanoparticles are aged in sewage treatment plant effluent.

**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 spreading is one of the methods used for 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 Ag nanoparticles (AgNPs) [3]. Moreover, AgNPs are mostly transformed to Ag sulphide nanoparticles (Ag-SNPs) due to the reducing conditions present in the wastewater treatment plant (WWTP) [4]. Recent studies suggest the possibility of AgNP residuals because of the partial sulfidation of AgNPs [5]. Land spread of biosolids might lead to the transfer of AgNPs and Ag-SNPs to the soil which could pose harm to soil organisms. Hence, this study aims to investigate the toxic effect of AgNPs on earthworms (Eisenia fetida) and isopods (Hyalella azteca). AgNPs and Ag-SNPs are tested in order to investigate their possible differences on the survival and reproduction of Eisenia fetida and Hyalella azteca, which is suitable species for soil ecotoxicology testing. The results are expected to address the possible threats of AgNPs and its transformation product, Ag-SNPs, on soil ecosystem in the case of their spread via biosolid application. Polyanlypyrrolidone coated AgNP (AgNP-PVP) and AgSNP are tested in order to investigate their possible differences on the survival and reproduction of Eisenia fetida and Hyalella azteca. Therefore, lethal and/or reproductive toxicity are evaluated by considering the Ag concentrations in the exposure media (soil and porewater) and in the animals. Microarray analysis is performed to assess the potential ecological risk to soil organisms are determined. References [1] Ex-post evaluation of certain waste stream Directives Final report European Commission – DG Environment 18 April 2014 retrieved from http://ec.europa.eu/environment/waste/pdf/target_review/Final20%20Est-Post.pdf [2] Johnson, A.C., et al. (2014). Chemosphere, 112, 49-55. [3] Topuz, E. et al. (2014). J. Hazard. Mater. 287, 68-75. [4] Topuz, E. et al. (2013). Waste Manag. 33, 1870-1881. [5] Kent et al. (2014), Environ Sci Technol, 48, 8564-8572. [6] Castro-Ferreira et al. (2012). Chemosphere, 87,1222–1227. Acknowledgement This study is funded by Horizon 2020 Marie Sklodowska-Curie Actions Individual Fellowships Project “TESinSAB” (Project Number: 704803) and Istanbul Technical University, Scientific Research Projects Fund (Project # 39961).

**MO403**

**Short-term induced molecular stress responses in coelomocytes of Eisenia fetida earthworms in vivo exposed to silver nanoparticles**

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In recent years the number of products containing nanoparticles (NPs) has increased massively. The subsequent release of NPs into the environment has led to the need to assess the potential ecological risk to soil, water and air. Silver nanoparticles (AgNPs) 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 in vivo study is to understand the effects produced by AgNPs (5.0824 nm sized 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 for 1, 3 and 14 d. Then, the transcription levels of selected genes associated to oxidative stress (Catalse) and metal detoxification (MTs-metallothioneins) were determined in coelomocytes extracted from exposed earthworms. In addition, the enzymatic activity (Catalse) and protein content (MTs) were quantified. The responses varied significantly among days, exposure concentration and Ag form. Exposure to Ag-NPs led to...
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 D. veneta coelomocytes that precede other responses at higher levels of biological organization. The responses in transcriptional 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
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With the rapid development of nanotechnology and its broad applications, a wide variety of engineered nanoparticles are used in commodities, pharmaceuticals, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO2-NPs) are one type of metal oxide that has been reported to have biomedical application. 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). A primary size of 5 nm, NM-300K were more marked when added to effluent or in ASTM medium. The dispersant used in ASTM (4% w/w of each Tagat® TO and Tween® 20) showed both significant decreases (AChE, GST, CAT) and increase (LDH) of enzymatic activities in dispersion-control relatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent 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 (125 µg/L) 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 the interaction of NMs with sewage sludge may alter the susceptibility of daphnids to pollutants, suggesting the need for further study on the effects of NMs on daphnids in real-world conditions.

MO405
The uptake of pristine and aged silver nanoparticles by wheat, Triticum aestivum, in a soil exposure
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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. saponification of Ag in waste water). 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 shoots. 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
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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 effects of aged particles in these environments are not well 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 NPs. 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, nanoComposite) and TiO2 particles (uncoated 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). The bioaccumulation of Ag and TiO2 NPs in soils. Effects of the pristine and aged particles on the metabolic activity, lysosomal integrity, reactive oxygen species formation, immune response and coelomocyte population are assessed. 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
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The increasing 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 on bioassays of Daphnia magna, a commonly used model species for ecotoxicological studies. Cerium oxide nanoparticles (CeO2-NPs) used in commercial applications are likely to be present in commercial and industrial effluents (NMs) used in commercial applications are likely to be present in commercial and industrial effluents. 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). The dispersant used in ASTM (4% w/w of each Tagat® TO and Tween® 20) showed both significant decreases (AChE, GST, CAT) and increase (LDH) of enzymatic activities in dispersion-control relatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent 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 (125 µg/L) implies 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 the interaction of NMs with sewage sludge may alter the susceptibility of daphnids to pollutants, suggesting the need for further study on the effects of NMs on daphnids in real-world conditions.

MO408
Outlining the behaviour and ecotoxicity of biomedical nanoparticles in aquatic consumers
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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 nanomaterials. Therefore, this project was to detect and characterize MNMs in the tissue of animals collected at the end of the exposure period. The derived accumulation factors and 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 concentration models and measurements, in biosolids, was 5.01 mg/kg and, in

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 nanoflours. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoflour with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken comparing the effects of this silver nanoflour with silver nitrate using the following internationally accepted standard ecotoxicity testing: Toxicity to the alga, Pseudokirchneriella subcapitata (OECD Test Guideline No. 201). Long-term toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoflour 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 3 kDa centrifuged filtered were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 µm) and centrifuge filters were condition 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 nanoflour 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 via ingestion test of particulate Ag and its bioavailability of dissolved ionic silver, also investigated in the ecotoxicity tests over a period of 28 days (following OECD Test Guideline No. 29), with measurements of the same three silver fractions. This showed a different dissolution behaviour in both test media, which agreed with observations in the ecotoxicity tests.

MO411 Investigations on the uptake pathway and accumulation of silver from manufactured silver nanoparticles in the freshwater amphipod Hyalella azteca

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Testing nanoparticle (NMs) under environmentally relevant conditions is an important aspect regarding the risk assessment of nanomaterials that enter the water cycle. The aim of this study, therefore, was to evaluate the uptake and the fate of ENPs in the freshwater 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, via ingestion test of particulate Ag and/or the bioavailability 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. Both had no direct contact to the test vessel containing Ag NMs. The study was carried out with five replicated test vials with two groups of amphipods 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 corelative 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

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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 concentration 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 μg/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 what metals and DOM need to regulate the ecotoxicity and, thus, 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 streambeds 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 Metacyclops gracilis a widespread hyperbetic species. Toxicity of AgNps was related with DOM concentrations and showed a non-significative 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. Aravanitou, F. Andreou, I. Manariotis, 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 effect of ZnO NPs on the growth of the synthetic wastewater was assessed using a thin glass capillary, weighted and analysed. Three pooled samples of 4 nanomaterials underwent 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 naupliar 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 (Ag 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 naupliar development was assessed. Extensive characterization of the particles in synthetic wastewater, seawater and exposure media was performed with dynamic light scattering (DLS), ultraviolet–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 particle types were stable under exposure conditions. Initial uptake experiments show that ZnO and TiO2 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.

MO414 Effects of sunscreen-screened TiO2 nanoparticles on freshwater and marine organisms
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Sunscreens represent one of the main source of engineered TiO2 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 (Psuedokirchneriella subcapitata; Dunaliella tertiolecta) and crustaceans (Eubranchipus venustus). Microalgae growth rate indicator for growth rate and 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.

MO415 Silver nanoparticles affect the early development of Tisbe battagliai: pristine vs aged particles
A. Georghioupolou, Norwegian Institute for Water Research; N.V. K. Farkas, SINTEF Environment; J. H. Landau / Institute of Biology; K. Kristiansen, Norwegian Institute for Water Research; P.A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SIOTEK 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 naupliar 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 (Ag 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 naupliar development was assessed. Extensive characterization of the particles in synthetic wastewater, seawater and exposure media was performed with dynamic light scattering (DLS), ultraviolet–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 particle types were stable under exposure conditions. Initial uptake experiments show that ZnO and TiO2 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.

MO416 Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanorodropes and silver chloride
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The relatively recent development of engineered Ag nanoparticles has expanded silver applications considerably. Silver nanoparticles (AgNP) tend to agglomorate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like Parhyale hawaiensis, 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 hawaiensis 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 into fish feed. Fish were fed fish feed for 4 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 Spectrometry (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feed, reaching 8.4±0.7 ng mg-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 absorbed from AgNP feed, reaching 8.4±0.7 ng mg-1 for AgCl, at the longest exposure time. The increase of silver concentration was related to the exposure duration.
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 hemolymph and oxidative DNA damage
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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 functionalizations that change their chemical and physical properties to enhance their suitability for different industrial applications. However, despite of the large array of available CNM 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. The current study was therefore performed. The exposure (28 days) to unfunctionalized MWCNTs (Ni-MWCNTs) in comparison with functionalized MWCNTs (f-MWCNTs), by introducing polar groups such as carboxyl 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. Alterations 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 Ni-MWCNTs. The results demonstrated that both Ni-MWCNTs and f-MWCNTs are able to modify the oxidative status, neurotoxicity and metabolic capacity of the Manila clams R. philippinarum and Ni-MWCNTs proved to be more toxic than f-MWCNTs. Moreover, the results indicated that the functionalization of MWCNTs with carboxyl groups enhanced the toxicity effects observed with the unfunctionalized MWCNTs.

MO418
Assessment of genotoxic and proinflammatory effects of different Silica and Titania Nanoparticles on human bronchial cells
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The widespread production and use of titanium dioxide (TiO2) and silica (SiO2) nanoparticles (NPs) in consumer products and in different industrial and medical applications raises concerns about their possible toxicity. We studied potential interactions of these CNMs with human bronchial (BEAS-2B) cells exposed to 24h to 0.1-100 µg/ml of selected NMs to evaluate: cytotoxicity (trypan blue assay), direct/oxidative DNA damage (Fpg-comet assay) and inflammatory effects (IL-6, IL-8 and TNFα release by ELISA). In culture medium NM200 was better dispersed than NM203, NM100 resulted better dispersed than NM101 at 100 µg/ml and both titania showed similar agglomerate sizes at 10 µg/ml. We found lack of cytotoxicity for all NPs. Slight direct DNA damage at 10 and 100µg/ml and slight oxidative DNA damage at the lowest concentration were induced by NM200. NM203 induced dose-dependent direct DNA damage statistically significant at 100 and oxidative DNA damage at low concentrations. NM100 induced dose-dependent direct DNA damage and oxidative DNA damage at 1 and 10 µg/ml. Direct DNA damage, statistically significant at 10 and 100 µg/ml, and induction of oxidative DNA damage at 100 µg/ml were found for NM101. All silica NPs induced slight IL-8 release at 100 µg/ml, NM203 induced also IL-6 release at 10 and particularly at 100 µg/ml (262.2 fold of control). Both TiO2 NPs induced slight IL-8 release at 100 µg/ml but only NM101 induced significant IL-6 induction at 100 µg/ml. The findings show higher genotoxic/oxidative and inflammatory effects for NM203 in respect to NM200, probably due to its higher surface reactivity determining a strong interaction with the proteins in the medium and higher protein-mediated cell interaction. The findings also show DNA damage for both TiO2-NPs and oxidative DNA damage for NM101, correlated with the proinflammatory IL-6 cytokine induction, probably due to its smaller size, higher agglomeration tendency and capacity to induce ROS. This study is partially financed by FP7-NAOnoREG 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 Biological and Environmental Engineering; R. Kaegi, Eawag - Swiss Federal Institute of Aquatic Science and Technology

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 this research we will develop a protocol that simulates the transformations or ‘aging’ ENMs experience 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 different gold nanoparticles (AuNPs) 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 we 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 aged ENMs into the environment, the effects of multiple transformations induced by a WWTP on the aggregation behavior of the ENMs will be evaluated. Ultimately, this will help refine our understanding of ENM environmental fate.

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 towards more ecologically relevant assessments. We have recently identified that 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. Whilst 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 (AgNP) we investigated the pathways by which these materials 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 coating displacement strategies have for the fate of these materials and the impacts of any surface coatings (e.g., electrostatically stabilised citrate and sterically stabilised PEG coatings) have upon the route of uptake of CeO2 and AgNPs and transformations they undergo during sediment exposures. Accumulation of CeO2 through dietary uptake is linked to their strong associations to the solid fraction of

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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 determine what surface chalcophile elements contribute to the oxygenation. Towards this end, we are using our new 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 photoreduction (photodynamic activity), and fluorescein dye conversion (ROS generation).

MO422

**Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles**

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Organic matter can shape the transformation of engineered nanomaterials (ENM) and environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

**MO423**

**Evaluating spICP-TOF-MS for Exploring Environmental Nano-scale Processes**

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The advent of single particle ICP-TOF-MS (spICP-MS) has helped advance the field of nanotechnology, specifically at concentrations and in matrices that are environmentally relevant. However, the concentration of naturally occurring nanoparticles (NPNs) and nanomaterials 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 introduction of ICP-time-of-flight mass spectrometry (ICP-TOF-MS) is potential to overcome these challenges, as elements are detected quasi-simultaneously at dwell times of 46 μsec, covering nearly the entire atomic mass range (7-250 m/z). By examining differences in the chemical composition on a particle-by-particle basis, NPNs 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 characterized two systems, each utilising single particle analyser, 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 the apply to environmentally and geochemically relevant systems. To illustrate this study, we used a multielement detection methodology; single particle analyses were performed on both a quadrupole ICP-MS and an ICP-TOF-MS, and using 3 ms and 100 μs 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 characterized and compared with low and another single particle analysis techniques for both their high resolution and their potential for environmental applications, including the photocatalytic treatment of contaminants. While 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 functionality 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 regarding their potential for environmental impact. Very little is known regarding the potential impacts associated with the release of these nanodrugs or their systems. Some studies have had 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 100 nm in diameter) with a non-reactive methyl polymer and fluorophore coating, we have traced their uptake and tissue distribution 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 zebrasfish 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 zebrasfish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

**MO424**

**Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy**

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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 functionality 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 100 nm in diameter) with a non-reactive methyl polymer and fluorophore coating, we have traced their uptake and tissue distribution 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 zebrasfish 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 zebrasfish 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)
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 Analyses; I. Hilber, Agroscope / Environmental Analyses; 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 solution, among these, adsorption is the most common used one. Biochar (BC) accumulate in the environment. For these reasons, isomers:

- L. Silvani, Use of biochar for hexaclorocyclohexane sorption: a mechanistic approach
- A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology

Comparison of the concentration ratio method using sampler differences between the field dissolved concentrations. All samplers had been additionally loaded with 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 lab and field. This study describes the testing of the approach in situ out in the field. The sampling location was a storm water retention pond collecting storm water runoff 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 hexaclorocyclohexane sorption: a mechanistic approach L. Silvani, 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, teratogen 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 which the concentration of total HCHs was measured in the reference area. Variational 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 (BCa), from greenhouse tomato waste (BCan) and from durian shell (BCd), 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 same 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 cm thick, 0.5 cm height, 10 ± 0.1 cm²) covered as a passive sampler for assessing the HCHs concentrations in water. The sorption and performance of the biochars is related to their physical and 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 of Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers M. Renningerhaus, RWTH Aachen / Bioi Bioge, T. Parkerton, ExxonMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Engineering

Spatial Distribution of HOCs on the Palos Verdes Shelf Superfund Site A.R. Taylor, University of California Riverside / Environmental Sciences; J. Wang, University of California Riverside; D. Schlenk, J. Gan, University of California, Riverside / Department of Environmental Sciences

Hydrophobic organic contaminants (HOCs), such as DDTs, PCBs, and currently used pesticides contaminate soils and sediments all over the world. As they are hydrophobic in nature, these compounds are resistant to both chemical and physical degradation while also having a strong affinity for soil or sediment particles and organic matter. Often, this contamination is due to the historic or current use and manufacture of these compounds, such as the widespread contamination of the Palos Verdes Shelf by DDTs and PCBs, which continue to pose health hazards to ocean organisms and humans that eat fish from this area.

Several current use pesticides, such as fipronil and pyrethroids, have also been detected in sediment from the shelf during preliminary experiments, indicating that these contaminants may have been deposited onto the shelf via urban waterways. In this study, we assessed the spatial distribution of current-use insecticides pyrithiones and pyrethroids in the top 2 cm of sediment on the Palos Verdes Shelf Superfund Site.

Concentrations of total pyrethroids (Pyrethroids = α of bifenthrin, fenpropathrin, cypermethrin, deltamethrin) were measured in all of the biochars, a contaminant trap was used for one of the biochars was recovered from an agricultural field site, four years after application. 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 that pyrogenic 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).

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. Fuchs, 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 passive samplers have to be used in 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 lab and field. This study describes the testing of the approach in situ out in the field. The sampling location was a storm water retention pond collecting storm water runoff 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 two hours 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.

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, ICGRAS U.Porto, CIMAR CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruzeiro, CIMAR CIMAR LA, Porto, CEF FCTUC U.Coimbra; E. Rocha, ICGRAS U.Porto, CIMAR CIMAR LA The study shows that the presence of 16 priority compounds (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/exports 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/g dry weight (dw) in suspended fraction and ≈ 5 ng/L in dissolved fraction. The leachable fraction was generally greater for more hydrophilic PACs, such as the 16 PAHs, that is with more polar PACs composed of two or three rings. Concentrations attained ≈ 52 μg/g dw in surface sediments, ≈ 5 ng/L in water. In view of the global amounts, concentration variability, increase sample throughput and to produce high quality data. A review. Calculation of the partitioning coefficients is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals, partitioning coefficients are closely related to the ability of a compound to partition between the solid phase and the aqueous phase. This work compares the performance of different methodologies to determine partition coefficients for hydrophobic chemicals. The literature review shows that different methodologies have been used to determine partition coefficients, including equilibrium distribution experiments, shake flask experiments, and column experiments. The most commonly used method is the equilibrium distribution experiment, which involves equilibrating a sample of the chemical with a known volume of solvent and measuring the concentration of the chemical in both the solid and aqueous phases at equilibrium. This method is simple and straightforward, but it can be time consuming and requires specialized equipment.Alternative methods, such as shake flask experiments and column experiments, have been developed to overcome some of the limitations of the equilibrium distribution experiment. Shake flask experiments involve mixing a known volume of the chemical with a known volume of solvent and measuring the concentration of the chemical in both the solid and aqueous phases at equilibrium. Column experiments involve passing a known volume of the chemical through a column containing a known volume of solid phase and measuring the concentration of the chemical in the effluent at equilibrium.

MO432

Occurrence and availability of PACs and total AhR agonists in contaminated soils — Estimation of the risk of bioavailability, uptake and bioaccumulation.

M. João Rocha, ICGRAS U.Porto, CIMAR CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruzeiro, CIMAR CIMAR LA, Porto, CEF FCTUC U.Coimbra; E. Rocha, ICGRAS U.Porto, CIMAR CIMAR LA. The study shows that the presence of 16 priority compounds (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/exports 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/g dry weight (dw) in suspended fraction and ≈ 5 ng/L in dissolved fraction. The leachable fraction was generally greater for more hydrophilic PACs, such as the 16 PAHs, that is with more polar PACs composed of two or three rings. Concentrations attained ≈ 52 μg/g dw in surface sediments, ≈ 5 ng/L in water. In view of the global amounts, concentration variability, increase sample throughput and to produce high quality data. A review. Calculation of the partitioning coefficients is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals, partitioning coefficients are closely related to the ability of a compound to partition between the solid phase and the aqueous phase. This work compares the performance of different methodologies to determine partition coefficients for hydrophobic chemicals. The literature review shows that different methodologies have been used to determine partition coefficients, including equilibrium distribution experiments, shake flask experiments, and column experiments. The most commonly used method is the equilibrium distribution experiment, which involves equilibrating a sample of the chemical with a known volume of solvent and measuring the concentration of the chemical in both the solid and aqueous phases at equilibrium. This method is simple and straightforward, but it can be time consuming and requires specialized equipment.Alternative methods, such as shake flask experiments and column experiments, have been developed to overcome some of the limitations of the equilibrium distribution experiment. Shake flask experiments involve mixing a known volume of the chemical with a known volume of solvent and measuring the concentration of the chemical in both the solid and aqueous phases at equilibrium. Column experiments involve passing a known volume of the chemical through a column containing a known volume of solid phase and measuring the concentration of the chemical in the effluent at equilibrium.

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. Giessy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Nutrition Sc. Centre; M. Ringwall, Orebro University / Man-Technology-Environment research centre (MTM) Polycyclic aromatic hydrocarbons (PAHs) are common contaminants at industrial sites contaminated with PACs 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 depending on contamination source and weathering processes in the environment. Recently, a new method to determine the availability of PACs was available in soils, which global amounts (Σ16PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≈ 52 μg/g dry weight (dw) in suspended fraction and ≈ 5 ng/L in dissolved fraction. The leachable fraction was generally greater for more hydrophilic PACs, such as the 16 PAHs, that is with more polar PACs composed of two or three rings. Concentrations attained ≈ 52 μg/g dw in surface sediments, ≈ 5 ng/L in water. In view of the global amounts, concentration variability, increase sample throughput and to produce high quality data. A review. Calculation of the partitioning coefficients is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals, partitioning coefficients are closely related to the ability of a compound to partition between the solid phase and the aqueous phase. This work compares the performance of different methodologies to determine partition coefficients for hydrophobic chemicals. The literature review shows that different methodologies have been used to determine partition coefficients, including equilibrium distribution experiments, shake flask experiments, and column experiments. The most commonly used method is the equilibrium distribution experiment, which involves equilibrating a sample of the chemical with a known volume of solvent and measuring the concentration of the chemical in both the solid and aqueous phases at equilibrium. This method is simple and straightforward, but it can be time consuming and requires specialized equipment.Alternative methods, such as shake flask experiments and column experiments, have been developed to overcome some of the limitations of the equilibrium distribution experiment. Shake flask experiments involve mixing a known volume of the chemical with a known volume of solvent and measuring the concentration of the chemical in both the solid and aqueous phases at equilibrium. Column experiments involve passing a known volume of the chemical through a column containing a known volume of solid phase and measuring the concentration of the chemical in the effluent at equilibrium.
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; S. Nielsen, Technical University of Denmark / Department of Environmental Engineering; M. Holmstrup, 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 are 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 alkalanes 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 (-)-Limonene and (+)-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. Campana, 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 Refineries 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 the hazard of 15 petroleum substances tested in this study. Laboratory work was performed to determine the extent to which biological effects vary with the chemical activities of hydrocarbons in the environment. The measured BE data provide an analytical surrogate which is then thermally desorbed unto a gas chromatography for quantification by flame ionization detection. The measured BE data provide an analytical surrogate for determining the biological activity of petroleum substances. 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 algae growth inhibition and springtail toxicity tests. Further analyses of exposure parameters are in progress to better understand and quantify the resulting toxicity.

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. Juhel, 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 (BAFs, wet weights) were calculated for all the samples/sites and log BAFf avg. 4.0±0.3, 4.4±0.3, 4.7±0.3, 3.9±0.7 and 4.3±0.4 for galaxolide, traseolide, phantolide, cephalocele 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. Bräunig, The University of Queensland / Queensland Alliance of Environmental Health Sciences (QAEHS); S. Schaefler, 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 sorbed on sediments. In this study, the freely dissolved concentrations (Cfree) 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 (Conc tot) 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 able to detect AhR, the peroxisome proliferator-activated 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 Cfree vs. Conctot will enable assessing the actual risk of the potential hazard of those chemicals that might be released in future scenarios (Cfree, wet weight). The present work calls for more detailed studies at specific sites and testing of additional endpoints with the aim of obtaining a complete picture of mixture effects caused by the freely dissolved and total concentrations of hydrophobic organic chemicals in sediments.

MO441
Bioaccumulation of hydrophobic organic compounds in aquatic biota: addressing current challenges for in tissue passive equilibrium sampling
E. Rojo Nieto, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; J. Koschorreck, Umweltbundesamt; m. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology

Organisms living in environments contaminated with Hydrophobic Organic Compounds (HOCs) can enrich these chemicals, a process known as bioaccumulation. Current 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 bioaccumulation (uptake + metabolic activation). This shortage in understanding 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 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 environmental compartments (sediment, water, biota).

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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 contaminants, covering a Kow range from 5.66 to 7.15. Reference: [1] Rusina TP, Carlsson P, Vrana B, Smedes F. 2017. Equilibrium passive sampling of POP in lipid-rich and lean fish tissue: Quality control using performance reference compounds. Environ. Sci. Technol., DOI: 10.1021/acs.est.7b03113.

MO442 Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, malagape 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 megalopae collected over three years from multiple estuaries in the NGOM from Texas to Florida were tested for alkylphenol contamination using GC/MS. We found alkylphenols to occur in 100% of blue crab megalopae with 4-nonylphenol (NP), butylated hydroxytoluene (BHT), and 2,4-di-tert-butylphenol (DTBP). NP is an alkylphenol known to impair endocrine function and concentrations detected in megalopae 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 megalopae 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 ecotoxicological 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 impact on living organisms is generally ignored. Perylene clusters (PNCs) are a type of homogeneous HOCs that are long-lived in the environment and are abundant in single-cell microalgae. Perylene is often present in combination with PAH, single-molecule fluorescence microscopy (SMFM) with a microfluidic flow chamber and temperature control has enabled us to track the dynamic process of perylene bioaccumulation in single bacterial cells and examine the cell-to-cell heterogeneity. Although with identical genomes, individual E. coli cells exhibited a high degree of heterogeneity in perylene accumulation dynamics, as shown by the high CV and efficient of variation (CV = 40). This remarkable heterogeneity was exhibited only in live E. coli cells. However, the bioaccumulation of perylene in live and dead S. aureus cells showed similar patterns with a low degree of heterogeneity (CV = 0.36). We found that the efflux systems associated with Tol C played an essential role in perylene bioaccumulation in E. coli, which caused a significantly lower accumulation and a high cell-to-cell heterogeneity. In comparison with E. coli, the Gram-positive bacteria S. aureus lacked an efficient efflux system against perylene. Therefore, perylene bioaccumulation in S. aureus was simply a passive diffusion process across the cell membrane. With the use of SMFM, the motion and distribution of perylene nano-clusters (PNCs) formed in water at very low concentration were visualized with high temporal and spatial resolution. Moreover, the transport of PNCs across the cell membrane was also real-time captured, demonstrating that they entered macrophage cells by endocytosis. Supplemening the well-recognized routine of passive diffusion through membrane lipid bilayer, the uptake of HOCs in the form of nano-clusters by endocytosis was proposed to be an additional but important mechanism for their uptake into living cells. HOCs distributing in the environmental systems in the form of nano-clusters, as exemplified by PNCs in this study, may have significant implications for understanding their environmental fate and potential toxicological effects.

MO444 Impregnation factors of freshwater fish by organic micropollutants in the Marne Hydrographic network
N.F. Molbert, UPMC UMR METIS 7619 / Biogeochemistry; M. Cheveuille, EPHE / UMR METIS 7619; F. Alliot, EPHE / UMR Metis; R. Santos, HEPIA; J. Mouchel, UPMC UMR METIS CNRSUPMC; A. Goutte, EPHE / UMR METIS
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 metabolizable 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. Pheratalates were the most abundant chemicals, with concentrations in fish muscles in the range 41.6-2200 ng 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 Marne hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis were less contaminated. In the study of 60 species, 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 sunscreens to protect human skin against harmful effects of UV radiation. The pathways into the marine environment are either indirect by wastewater treatment plant discharge or direct by recreational activities like bathing and boating. Four benzotriazoles (BHT, DTBP, NP and DTBP) 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 sediment (logKow > 3) and have potential for persistence or pseudo-persistence. Environmental data from the North and Baltic Sea, the western Mediterranean Sea and the Baltic Sea are compiled in this study. Sediment samples of the North and Baltic Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as following: 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 approximately 15 g of deactivated silica and approximately 5 g sediment that was spiked with appropriately isotopically labelled standards. The cells were extracted using dichloromethane for three 10 min-cycles at 100 °C. The extracts were solvent-changed to methanol and reduced in volume to 150 μL. The instrumental analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadropole LC/MS, Agilent Technologies, Germany) equipped with an API-Q source and a C18 column (Eclipse Plus RRHD 1.8 μm, 2.1 x 150 mm, Agilent Technologies, Germany). Total Organic Carbon (TOC) analysis was carried out with aliquots of the freeze-dried samples using a LECO RC612 multihasse (Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the North and Baltic Seas for the first time. Several substances have been identified in concentrations in the low ng/g dw range.

MO446 Is Lake Como a “uniform lake”? Information from its inhabitants (zooplankton and fish)
M. Ghezzi, University of Insubria (Como) / DiSTA; A. Buffo, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; R. Perna, University of Insubria; S. Polesello, Water Research Institute- CNR / Water Research Institute; S. Valsecchi, Water Research Institute - Italian National Research Council IRSA-CNR; R. Bettinetti, University of Insubria / DiSTA Lake Como, a subalpine lake (Northern Italy), is an oligomictic lake, with complete water mixing occurring after particularly windy and cold winters. It presents a typical shape of an upside “Y” where a western, eastern and northern basin can be identified. In more detail, the western branch is distinctly separated from the rest of the lake by an underwater ridge, where the highest depth is measured (425 m at
Argenio), and does not present an outlet, resulting in a longer real water renewal time. On the other side, waters of the eastern branch are encouraged to flow towards south directly through the Adda River, which is also the main inlet in the northern branch. Western and eastern branches also present different level of trophic status. In the present work, we investigate if these main morphological features can lead to differences a) in zooplankton density and biomass, b) in the interactions between zooplankton and the cells and c) in levels of pollution between the pelagic areas of the two branches, evaluated along a seasonal sequence. Preliminary data tell that the taxa composition of the pelagic planktonic communities is the same in the basins but differences in density and biomass are highlighted. These differences are found in levels of contamination of legacy compounds (DDT, PCB) while there are not differences between the two branches in concentrations of perfluoralkyl substances (PFAS).

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 / Institute of Marine Biology; C. Chu, National Dong-Hwa University / Institute of Marine Biology. 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 chiui), rotifers (Brachionus sp.), and copepods (Acartia tonsa) culturing in a gas-permeated 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 to those 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 (Kow) in plankton, however the different linear regression slopes of log BCF and log Kow 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. Bengen, I. Politowski, P.M. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Hochschule Ruhr-Universität Bochum. 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 changes in their environmental behaviour. The study investigated the fate of MWCNT in the water phase is very short; due to agglomeration and sedimentation 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 their properties and lead to changes in their environmental behaviour. The duration of the MWCNT in the water phase is very short; due to agglomeration and sedimentation 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 their properties and lead to changes in their environmental behaviour. The duration of the MWCNT in the water phase is very short; due to agglomeration and sedimentation 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 their properties and lead to changes in their environmental behaviour. The duration of the MWCNT in the water phase is very short; due to agglomeration and sedimentation 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 their properties and lead to changes in their environmental behaviour. The duration of

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule
B. Journel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA. Fate of 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 Kow and adsorption) have a non-negligible impact on how substance’s behaviour is modelled 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 the experimental results are subject to imprecision. Due to analytical difficulties, parameters such as water solubility and Kow are often expressed as “lower than” or “higher than” and have no defined value. Additionally, model softwares such as EUSES impose maximum value for Kow 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 Kow, 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 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. Vervloets, 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 monitored in environmental samples. However, 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 constructed to establish 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: Methodology of the analysis and methodological and environmental occurrence
T. Combi, Instituto Oceanográfico da Universidade de São Paulo / Instituto Oceanográfico; 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), personal care products (PCPs)) can lead to contamination of sediments that could be potentially toxic to humans. The existence of such a high number of compounds in the environment leads to interferences during chemical analysis, hindering the assessment of the occurrence and distribution of contaminants in environmental matrices. Thus, the development and optimization of analytical methods that can detect multiple classes of compounds at very low levels and the contamination assessment in marine and coastal areas are among the most complex and current issues in environmental chemistry. Possible adverse effects related to some groups of PCPs, such as potential to accumulate through the trophic food chain and in human adipose tissues, endocrine disruption and hazard to coral reef conservation
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 for surface sediment samples from São Paulo coastal areas through microwave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyses (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EEMC) and fragrances (tonalide and galoxilide). The next steps of this work include testing additional extraction methodologies, extraction solvents 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. Łapczynski, 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 presented and discussed 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 Environmental 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 established to rank each material. This effort was made 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. Crumlish, King Fahad Security College / Forensic Science Department; A.A. Sterc, 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 polycyclic 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, tidal 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 tidal bags and sorption tubes, they did not give satisfactory results. Several carcinogenic or possibly carcinogenic compounds were identified in the combustion products, such as benzenes, naphthalene, anthracene and pyrene.

MO455
PbTk modelling of super-hydrophobic chemicals W. Lassé, K. 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 super-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 diffuse 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 I: linear alkylbenzene sulfonate (C12-LAS) and alcohol ethoxylate (C13EO8). Chemosphere. 72:850—862. 2. Sakuratani 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 Peg_en_pdf/dd_a9031-6a4-4995-8efc-3738162ba4e8

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 NSAIDs [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 in knowledge of deliberate poisoning to [migratory] wildlife globally. M. Odlin, 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. Staab, BASF SE; J. Roembke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, 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 probabilistic risk analysis software putting representativeness/variability 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.
F. Joyce, Cambridge Environmental Assessments; H.S. Schuster, Cambridge Environmental Assessments (CEA) / Aquatic Ecotoxicology
Mesocosms (which aim to replicate communities residing in edge-of-field waterbodies) are used as part of the higher tier aquatic risk assessment for plant protection products (PPPs) in the EU registration process. When setting up mesocosm studies, care should be taken to standardise communities present in each replicate to reduce variability and maximise statistical power; indicated by minimum detectable differences (MDDs). However, being dynamic and complex systems, variability can often still occur between replicates, which can affect the reliability and interpretation of the results. Statistically significant differences can occur due to natural variability rather than biologically relevant effects, but demonstrating this in regulatory authorities the results of a single mesocosm study can be challenging. One option is to contextualise the experimental results from a single study using available historical control data; this is an approach often used for laboratory studies performed under standard conditions. It is, therefore, proposed that this approach can be extrapolated to mesocosm studies, given that they are also performed under standardised conditions as much as possible. Cambridge Environmental Assessments (CEA) have a wealth of control data from historical mesocosm studies, with samples collected in spring, summer and autumn, thus capturing the variability in population and community dynamics over multiple years and seasons. Here we present our review of this historical control data, and how this provides a baseline to aid interpretation of results from individual studies, allowing an assessment of biological relevance and the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU003 Enhancing the utility of the ECOTOX knowledgebase via ontology-based semantic annotation.
The US Environmental Protection Agency’s Ecological Toxicology (ECOTOX) knowledgebase contains more than 30 years of reported single chemical toxicity effects data on aquatic and terrestrial organisms. Approximately 900,000 test results covering more than 11,000 chemicals and 12,000 species are available in ECOTOX. While the database is currently used by many sectors for a variety of purposes, a future goal is to allow for computational modeling of the data to identify novel adverse outcome pathways and networks, and assist in predicting species sensitivity. To accomplish these goals, the initial steps entailed:1) validating the chemicals within ECOTOX 2) mapping species to NCBI taxids and 3) mapping all relevant ECOTOX codes to corresponding ontological terms so chemical effects can be turned into computable phenotypic ontology classes. To semi-automate the code mapping, a Java-based lookup tool was developed using the ontology browser BioPortal (https://bioportal.bioontology.org/) REST API to conduct bulk code mapping. This tool was designed to make use of BioPortal’s annotator and recommender functions so that all ontological class identifiers relevant to a particular ECOTOX term would be returned and specific ontologies recommended. Using this approach, the majority of the 2000+ ECOTOX codes were mapped to ontological class identifiers; some terms required multiple identifiers to properly describe them. Further, manual curation was necessary for some of the results of the automated code mapping approach were evaluated against a set of manually annotated phenotypes as induced by exposures to ten well studied chemicals (atrazine, bisphenol A, cadmium, camptothecin, dioxin, EE2, malathion, or Tris(1,3-dichloro-isopropyl) phosphate) in six vertebrate species (carp, zebrafish, fathead minnow, mouse, rat, trout). The content of this presentation neither constitute nor necessarily reflect US EPA policy.

TU004 ECOTOX Knowledgebase: New tools for data visualization and database interoperability
C. Elonen, U.S. EPA/OR/ORD/NHEERL; J. Olker, C. LaLone, U.S. EPA / Mid Continent Ecology Division; D.J. Hoff, U.S. EPA ORD / Mid Continent Ecology Division; S. Erickson, M. Skopinski, S. Casey, A. Pilli, K.A. Fay, CSRA, Inc. The ECOTOXicology knowledgebase (ECOTOX) is a comprehensive, curated data resource that compiles 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 100,000 fields. Study details such as species, taxonomy 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 toxicological assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulation, 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. These additions 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 datawarehouse
F. Joyce, RWTH Aachen University; B. Schulz-Stanke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research
A steadily increasing number of databases in ecotoxicology and ecology combine and manage data from different studies 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. Automatic 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 combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from diverse sources including region specific collections, different earthworm communities.

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 Chemicals Agency; P. Proenca, EU Commission JRC / Directorate D Sustainable Resources Bioeconomy Unit
The potential impact of chemicals on aquatic ecosystems is assessed during the registration and authorization of plant protection products (PPPs) in the EU registration process. When setting up the aquatic risk assessment, this will represent a challenge, given that the studies differ in scope, de...
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 species, was used to test the stability of TBI as the feasibility to calculate effect values based on Species sensitivity distribution. 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 species and corresponding metrics - Choice of physical and Chemical 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 E-StUDIO program
F. Bignanzoli, 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 (OEFP) are core of the Commission Recommendation “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. However, the toxicity values are given for cancer and non-cancer effects. For PEF/CLA, those 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. Olijvecnik, University Parthenope; s. schiavo, ENEA CR; s. manzo, ENEA / SSPT-PROTEC-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 toxicological endpoints, i.e. the aquatic acute toxicity endpoint 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 used 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 TBI 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 it 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.

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 the real potential handlings of PPP, inside and beyond the agrosystems. However these 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). We also developed procedures to handle missing data and to detect mistakes in the indicated dosage or field size. Finally, a dataset of sprayer 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 use the potential handlings of PPP, inside and beyond the agrosystems. 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.

TU010 Using long-term datasets to assess the impacts of neonicotinoids on farmland bird populations in the UK over the last 21 years R. Lennox, The University of York / Environment; N. Isaac, NERC Centre for Ecology & Hydrology; R. Shore, Centre for Ecology & Hydrology (NERC); K. Arnold, University of York / Environment; W. Peach, Royal Society for the Protection of Birds; C. Brown, University of York / Environment Department. To date the majority of research regarding neonicotinoids (NNs) has been focused on pollinator species; however, little work has been done to investigate the potential long-term impacts of these pesticides on other taxa, such as farmland birds. Birds can be directly exposed to NNs via two main exposure routes: ingestion of NN-coated grain, or seedlings germinated from coated grain. With bird abundance data, NN usage records and UK cropping data, a poisson log-linear generalised mixed model was used to investigate whether there are any impacts of NN use on farmland bird populations over a period of 21 years. Specifically, the main objectives of this study were to 1) establish whether there is a relationship between species population growth and NN usage in the UK, 2) establish whether species traits, such as body weight and home range are correlated with any effect of NNs on species population growth when controlling for other factors (such as exposure risk) and 3) determine whether species traits, such as body weight and home range are correlated with any effect of NNs on species population growth when controlling for other factors (such as exposure risk). This study illustrates, that for a historic analysis of pollutants it is sometimes unavoidable to use the potential handlings of PPP, inside and beyond the agrosystems. 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.

TU011 Regression-based models reveal sources of pollutants in Norwegian marine sediments G. Everaert, Flanders Marine Institute / Laboratory of Environmental Toxicology and Aquatic Ecology; A. Ruus, NIVA / NIVA; D. Hjerrmann, NIVA Norwegian Institute for Water Research, K. Borgia, Department of Biosciences, University of Oslo / Department of Biosciences; N.W. Green, NIVA Norwegian Institute for Water Research / marine pollution; S. Boitsov, Institute of Marine Research; H. Jensen, Geological Survey of Norway; A. Poste, Norwegian Institute for Water
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 coordinates explained 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. Sörfjord 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, B. Catalano, ISPRA Institute for Environmental Protection and Research; G. Gerber, North West University / Environmental Sciences and Management; N. Smit, NorthWest University / Environmental Sciences and Management

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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 advent 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 beta diversity (uniparametric displays) and present a highest DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, γ-Hexachlorocyclohexane, were included in the analysis, significant relationships with cytochrome P450 and lipid energy reserves were observed. The result therefore indicated that biological responses were not related to DDT but rather to HCH exposure.

Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring (P)

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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 maximal capacity of 147.073 µg.g\(^{-1}\) and an equilibrium constant of 0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlighted a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the equilibrium 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 absorption behaviour and impact in periphytic microorganisms.

TU016
New insights into the biotransformation of sulfurluramid: 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 perfluoralkyl and polyfluoralkyl 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, Sulfurluramid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have investigated the biotransformation in activated sludge, marine sediments and soil. However, little information is available on the biotransformation process using metagenomics and metatranscriptomics. This study used Alillytouhea (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 this 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 Protochloramydius 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 ?
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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), cannot be synthesized de novo or in insufficient proportions by animals on their own. Seeding is thus widely used to study trophic interactions in food chains. Generally, microalgae with a high proportion of EPA, such as diatoms, are an excellent source of food for animals but the concentrations of these different fatty acids can vary according to the stage of growth of the organism and according to different environmental parameters including pesticide exposure (Brett et al. 2006; Robert et al. 2007, Burns et al. 2011, Fillon et al. 2016). Moreover, for several years, the intensive use of pesticides caused many problems to the environment, making pesticides major pollutants of aquatic ecosystems (Aydinbal and Porca 2004). The aim of this study is to investigate the impact of 3 pesticides on diatom’s fatty acids. To address this issue, a model freshwater diatom (Gomphonema gracile) was exposed to three herbicides, with three different cellular targets, at environmentally relevant and higher concentrations (diuron and S-methylchlor, C1=1 µg.L\(^{-1}\) and C2=10 µg.L\(^{-1}\), glyphosate, C1=5 µg.L\(^{-1}\) and C2=50 µg.L\(^{-1}\)). After a 1-week exposure, fatty acid compositions of diatoms were determined by gas chromatography. In comparison with control samples the percentage of 1) polysaturated fatty acids (PUFA) decreased with S-methylchlor contamination (C2=2); 2) saturated fatty acid (SFA) and monounsaturated (MUFA) decreased with diuron and glyphosate exposure (C2). The decrease of PUFA is a direct impact and can be explained by the mode of action of S-metolachlor which inhibits elongases. Concerning diuron and glyphosate, the decrease of SFA and MUFA can reflect an indirect effect, which can be explained by the mode of action of these two pesticides which respectively blocks electron transfer in photosynthesis, and inhibits the synthesis of aromatic aminoacids.
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 (TILV) 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 (TILV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TILV 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 TILV 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 TILV dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50).
- To explore TILV highly artificial environmental conditions, sacrificing the optimal 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 TILV under treatment of cohabitation.

**RESULTS:** In toxicity assay, LD50 estimate of Nile tilapia infected by I.P. injection with different TILV dosage was 576.25 TCID50 mL⁻¹. Under cohabitation scenario, disease parameters such as temperature and aquatic density. Results of toxicity assay and disease epidemics could provide insights into aquaculture management of TILV disease by controlling potential factors in tilapia ponds.

**Keywords:** Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

**TU021** Natural organic matter alleviates TiO2 and CuO nanoparticle toxicity in four algal species

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**Although the knowledge concerning synthetic metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted on TILV 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 OECD201 standard medium, using four freshwater species from three major algal groups: green algae (B. subcapitata subcapitata), diatom (O. subcapitata), 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 ions. 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. TiO2 significantly inhibited biomass production of both green algae in the standard medium (EC₅₀ = 13-41 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 CuO toxicity, TiO2 effects were at least in part due to observed cell heterogametization. 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.

**TU022** Impact of the antihistamine fexofenadine on structure and functioning of less-polluted 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. Fahlman, T. Bronid, J. Klaminder, Umea University / Department of Ecology and Environmental Science; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

**OBJECTIVE:** The aim of this project is to conduct a microcosm experiment, where the microbiologically 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. 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% (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 leaves. Accordingly, in water samples of the two substrates, substantial differences in the DOC quality were observed. Furthermore, fexofenadine exposure lead to a reduction in microbial community structure. To gain an in-depth mechanistic understanding of the observed effects, we are currently analyzing various related to microbial community structure and functioning.

**TU024** Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project INT-CATCH

M.D. Sermidshaw, Brunel University / Institute for the Environment; S. Marchegiani, Italian Institute of Health ISS / Environment Health; M. Caere, Italian Institute of Health ISS; O. Tcheremenskaia, Italian Institute of Health ISS /
Environment Health; L. Mancini, Italian Institute of Health ISS; C. Mancini, AECON / Environment Health; M. Delledonne, M. Rossato, University of Verona; F. Fatone, Università Politecnica delle Marche; A. Farinelli, J. Blum, D. Bloisi, University of Verona; A. Cordioli, Azienda Garese Naservi S.P.A. Peschiera del Garda; P. Varotto, Azienda Garese Naservi S.P.A. Peschiera del Garda; A. Tlili, Technical S.P.A. Milano; D. Calisi, Algorithma S.r.l. Roma; F. Giannone, Algorithma S.r.l.; R. Allabashi, Boku University; A. Parsons, L. Parsons, DESTREND Consulting Ltd.; J. T. Runnells, Brunel University / IFE; G.E. Brighty, Environmental Sustainability Associates Limited; T. Licha, Gottingen University; S. Malamis, Athens Technical University; T. Knutz, Go-Sys; A. Merkoci, ICREA; The European Project Horizon 2020 INTECATCH (Development and Application of Novel, Integrated Tools for monitoring and managing Catchments) has the main goal to recommend and deliver new tools and methods for the monitoring of surface water bodies in Europe. The tools foreseen by INTECATCH include sensors for the detection of heavy metals, nutrients, pH, temperature, pesticides, Escherichia coli, some of them are mounted on aquatic drones. An innovative tool of Intatch is the portable sequencing laboratory/tool for metagenomic analysis that is performed in different surface waterbodies (e.g. Garda lake) selected through an analysis of the pressures. Bacteria are collected after concentration of water samples that are filtered by an automatic system applied on the aquatic drones. Using portable devices, the genomic tool allows the DNA meta-barcoding on-site, where samples are collected, and deliver the full bacterial composition of the water analyzed, including pathogens. The validation of the metagenomic results is performed with the use of traditional microbiological analysis of raw water. The metagenomic data can support the monitoring of linked processes and allow understanding changes of the bacterial community which can reflect variations in water quality, and be linked for example to the presence of unknown chemical substances or mixtures. In addition, given its capability to detect pathogens, each portable genomic tool can provide a valuable rapid readout in case of emergencies, that are increasing in frequency due to the effects of climate changes, such as flooding. Similarly, the metagenomics data, linked to the informations of the other tools, can be also be used for the identification of pollution sources because the proportions of the bacteria groups vary in relation to several stressors (agricultural, urban, living stock, etc.).

TU025 Tolerance of sediment-microbial communities to copper indicates lake contamination
A. Tili, Eawag / Department of Environmental Toxicology; C. Boninneau, Irstea Lyon; A. Dabin, Irstea Lyon-Villeurbanne / UR MALY; E. Layeute, Universite Savoie Mont Blanc; B. Ferrari, Centre Ecotax EAWAGEPFL; S. Pesce, Irstea Lyon-Villeurbanne / Microbial ecology of anthropised river systems. In lakes, and fresh waters in general, sediments play a crucial role in biogeochemical cycles, and are often at the basis of the food-web. Heavy metals such as copper, zinc or silver can accumulate in lake sediments, which represent a potential source of metals to the aquatic environment. Therefore, the goal of this field survey was to examine the impact of copper contamination on microbial communities in lake sediments. 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 the type and extent of the stressors. Biofilms were sampled with an Ekman grab sampler at four sites, located around the lake and close to the shore. Samples were analysed for total metal concentrations, organic matter content, abundance of metal-resistance genes (e.g. copA and cusa), bacterial biomass, and bacterial community composition. Moreover, tolerance of microbial communities to copper was evaluated by performing the inhibition of bacterial secondary production and the extracellular enzyme β-glucosidase activity. Results showed a clear gradient of copper contamination, ranging from 30 to 350 mg.kg⁻¹ DM sediment. The results also demonstrated that chronic in situ exposure to copper induced a decrease of bacterial biomass and the bacterial community composition. Interestingly, tolerance measurements to copper were strongly and positively correlated to the copper concentrations in the sediments. Overall, our findings support the fact that microbial communities in sediments are a good indicator for metal contamination in aquatic ecosystems, and the suitability of microbial tolerance measurements to pinpoint specific effects of metals at the community level.

TU026 Current challenges and perspectives in aquatic and soil microbial community ecotoxicology
K.K. Brändle, University of Copenhagen / Department of Plant and Environmental Sciences; M. Schmidt-Jørgensen, UFZ - Helmholtz Cite Environment Research / Department of Bioanalytical Ecotoxicology; A. Tili, Eawag / Department of Environmental Toxicology
Assessing the impacts of chemicals still largely relies on approaches that are based on assays in simplified laboratory settings at the single-species or subspecies level. Yet, it becomes increasingly recognised that to draw conclusions on potential effects on ecosystems, it is essential to consider higher levels of ecological organisation, and more intricate risks on ecosystem structure and function. Microbial communities provide a large range of ecosystem services such as primary and secondary production, nutrient recycling, pollutant degradation, and are sources of biochemicals. Microorganisms are also primary targets for chemicals, which can lead to structural and functional alterations of microbial communities, with potential negative consequences for ecosystem functioning and environmental selection of antimicrobial resistance. Hence, a microbial community-level perspective in ecotoxicology is more important than ever. In this presentation we will first provide an overview on the current status of microbial community ecotoxicology research, in aquatic and terrestrial ecosystems, and to which extent this field is considered in environmental risk assessment and environmental decision-making. 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 effects and exposure.

TU027 Hydrodynamic conditions alter the tolerance of biofilm communities towards chemical stress
B. Holm-Hansen, Institute for Environmental Research / UFZ / Department of Bioanalytical Ecotoxicology; F. Larra, Helmholtz Center for Environmental Research / UFZ GmbH; S. Lips, Helmholtz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology; C. Anlanger, U. Risse-Buhl, M. Weitere, Helmholtz Centre for Environmental Research UFZ / Department of River Ecology; M. Schmidt-Janusek, UFZ - Helmholtz Cite Environment 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 the type and extent of the stressors. Biofilms were sampled with an Ekman grab sampler at four sites, located around the lake and close to the shore. Samples were analysed for total metal concentrations, organic matter content, abundance of metal-resistance genes (e.g. copA and cusa), bacterial biomass, and bacterial community composition. Moreover, tolerance of microbial communities to copper was evaluated by performing the inhibition of bacterial secondary production and the extracellular enzyme β-glucosidase activity. Results showed a clear gradient of copper contamination, ranging from 30 to 350 mg.kg⁻¹ DM sediment. The results also demonstrated that chronic in situ exposure to copper induced a decrease of bacterial biomass and the bacterial community composition. Interestingly, tolerance measurements to copper were strongly and positively correlated to the copper concentrations in the sediments. Overall, our findings support the fact that microbial communities in sediments are a good indicator for metal contamination in aquatic ecosystems, and the suitability of microbial tolerance measurements to pinpoint specific effects of metals at the community level.

TU028 Does fungicide exposure alter interspecific 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 of Environmental Sciences; M. Kerbach, University Koblenz-Landau / Institute for Environmental Sciences; C. Schöning, University 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. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment
Aquatic 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 changes in the fungal model community to diverse substances with different modes of toxic action (four sum concentrations ranging from 5 to 2500 µL/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. lagunensis and T. marchalianum) 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 μg/L). Species-specific qPCR assays proved to be a valuable tool for assessing ecotoxicological effects on well-defined ecological interactions within aquatic hyphomycetes. 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. Conduito 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. Letting, 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 deepest region of the lake (3 m). The subsequent sampling depth (0.5 m from surface) was 13 m (MESO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCCHI). The samples were characterised for their chlorophyll a content, nutrients, cyanotoxins 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 2x250 bp 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 EPI and 2.5x SECCCHI. The results showed that a peak of cyanobacteria was observed around 14/9/21.9 in the EPI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the MESO region. The abundance of the cyanobacterial composition was also observed for proteobacteria and actinobacteria. Our result suggests 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 compared to other 18S genes composition, it would be recommended in order to discard a possible contribution of phototropic eukaryotes.

**TU030**
Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope

M. Lettieri, European Commission Joint Research Centre Villeurbanne / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP); J. Ghahou, Irstea Lyon-Villeurbanne; m. masson, c. brosse, Irstea Lyon; B. Voltat, Irstea Lyon-Villeurbanne; C. Bonninède, 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, a static test. The development of the experiment (0 to 20 days) biofilm was grown on glass slides in water spiked with natural dissolved Cu concentrations as low as 0.01μM. The prokaryotic community structure was studied as impacts on algal biomass, photosynthetic pigment profiles and primary production. Induced Community Tolerance (PCT) using photosynthesis as the endpoint. Periphyton was exposed for subsequent analyses: dry weight, chlorophyll pigments fluorescence, photo-synthetic activity, microscopical microorganism identification, polysaccharide and protein contents. Biomass, proteins, polysaccharides and diatoms abundance increased significantly showing the growth of the biofilm during the experiment. No significant 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 algae between t2 and t4. Principal response curve (PRC) analysis showed significant changes over time of microeukaryota composition but no correlation (C0) and the C2 condition. Giliates were less impacted by Zr exposure than flagellates which tended to disappear in the C2 condition. Biofilm microorganism play a wide role in major ecosystem processes. Regarding these results, Zr exposure can impact the periphyton microorganism composition which could disturb periphyton key functions. A better understanding of effects of metals on microeukaryota 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

C.N. Doose, INRS - Centre Eau Terre Environnement; S. Morin, Irstea Bordeaux / UR EABX; C. Fortin, Institut national de la recherche scientifique Centre - Eau Terre Environnement

The growing world demand for metals results in increased metal mobilization in aquatic systems. Although the effect of metals on freshwater ecosystems is well documented, studies on the impacts of metal contamination on microbial composition and functioning are still lacking. Zirconium (Zr) is a tetravalent non-radioactive element for which the global demand is increasing in the last decades. Benthic microbial communities (periphyton) have shown good potential as a biomonitoring 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 immersed 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 0.2 ± 0.1 μM (C0), 0.5 ± 0.3 μM (C1) or 2.9 ± 0.3 μM (C2) of Zr (wet). One slide per section was sampled after 1, 2 and 4 weeks of exposure to Zr. The cell fraction (0.25) and the cell fraction (0.35) confirm the potential protective function of the EPS matrix.

Bioaccumulation levels of Cu in the young biofilm (20 days) were similar between the colloidal, capsular and cellular fractions. Finally, the isotopic approach showed that after 40 days of exposure, the isotopic ratios in the three fractions of the biofilm were similar to the ratio in water of the second phase of exposure (~0.25). These results suggest (i) an intense and rapid renewal of the biofilm and of the bioaccumulated Cu and (ii) that Cu concentrations in a mature biofilm at a given time reflect the last period of exposure. In addition, the isotopic ratios were very low, a significant difference of isotopic ratios between the EPS fraction (0.25) and the cell fraction (0.35) confirms the potential protective function of the EPS matrix.

The in-situ monitoring of Cu and Zr biota in lakes and rivers is of great interest, as it allows for monitoring the metal concentrations in the aquatic environment and for assessing the potential risks associated with metal exposure. The use of isotopic tracers allows for the discrimination of different sources of contamination and for the assessment of biogeochemical processes such as metal mobilization and metal accumulation in the biofilm. The results of this study suggest that the use of isotopic tracers could be a valuable tool for the monitoring of Cu and Zr biota in lakes and rivers.
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU033
A Time-series Study of Soil Microbial Community Compositional and Functional 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 petrodiesel, however, the biodiesel that 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 was assessed 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 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 alga was sensitive to alkalinity, SO4, O2 and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbaamazine/irbesartan/valsartan induced growth stimulation of N. palea and 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 (Monbéqui (France), Saragossa (Spain), Bidasoa (Spain) and Toledo (Spain)). Four campaigns of water sampling were realized during contrasted hydrological 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 alga was sensitive to alkalinity, SO4, O2 and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbaamazine/irbesartan/valsartan induced growth stimulation of N. palea and N. pelliculosa, respectively. Records for pharmaceuticals were observed for the other three sites, exceptional 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)

TU035
Can post-mortem data be used to monitor population health in response in the barn owl? L. Walker, Centre for Ecology & Hydrology; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shor, 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 outside these limits for the mean sex ratio for the model 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 overlap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat values overlap for females and males, respectively. The level of kurtois 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.

TU036
Identifying suitable marine biomonitor in South Africa: Mussels vs Whelks C. 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. Very 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 bioconcentration between mussels (Mytilus galloprovincialis) and whelks (B. lagenaria) as well as measure imposex prevalence in B. lagenaria at Bloubergstrand, Granger Bay and Green Point, Cape Town, South Africa. This was done in order to identify suitable bioindicators of ecotoxicity 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, Mo, Cd and Pb) were measured in intertidal sediment, M. galloprovincialis and B. lagenaria and imposex prevalence recorded in B. lagenaria. 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 biomonitor should be linked to purpose of investigation before selection of species, and mussels have been considered ‘ideal’ bioindicators of contamination in South Africa. Given the ubiquitous distribution of B. lagenaria along the South African coast, which is not the case for M. galloprovincialis which only occurs on the west and south east of the coast, the proposal is made that B. lagenaria could be considered as alternative bioindicators of ecotoxicants in contaminants of the region.

Recent developments in environmental risk assessment for polllinators (P)

TU038
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (bombyrus terrestris) J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinsson, University of Oslo / Department of Physics; K. Boga, Department of Biosciences, University of Oslo / Department of Biosciences; M. Grung, A. Nielsen, University of Oslo / Department of Biosciences

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 subtle effects of neonicotinoids on honeybee (Apis mellifera) physiology and on neonicotinoids in field-realistic does. However, ecological and physiological traits vary among bee species and studies on honeybees may not be comparable with those on non-Apis species. Bumblebees were exposed to three different dosages of imidacloprid through artificial nectar (sugar water), ranging from field realistic 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 alga was sensitive to alkalinity, SO4, O2 and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbaamazine/irbesartan/valsartan induced growth stimulation of N. palea and N. pelliculosa, respectively. Records for pharmaceuticals were observed for the other three sites, exceptional 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).
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 (rewards) and yellow water-filled (non-rewards) 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 no 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 notifiers 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 objective of this poster is to summarize available industry data, for active substances and formulated products on honey bee larval 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 calculation of risk quotients (RQs) for honey bee larvae. This considers exposure routes for the active substance (in field and off-field (PPP) and on seed treatment and granules) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers the possibility for refinement in a tier I risk assessment. This includes the refinement of exposure estimates from the screening step and also additional exposure routes, such as the exposure to flowering weeds in field and field conditions. According to the new “EFSA Guidance Document on the development of a whole colony (3 replicates, untreated) are compared to the results were 200 cells per hive were implied. The parameters compared are: BTR, brood and compensation indices.

TU040
Honeybee brood studies according to Oomen and OECD GD 75: Is there a difference in the brood termination rate under semi-field and field conditions* L. Franke, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; O. Klein, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; J. Fricke, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; J. Sorri, TRIALCAMP SLU; T. Vollmer, Eurofins Agroscience Services Ecotox GmbH / Field Ecotoxicology; S. Knaebe, EAS Ecotox GmbH / Ecotoxicology Field

The first objective of this poster is to summarize available industry data, for active substances and formulated products on honey bee larval 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 substance (in field and off-field (PPP) and on seed treatment and granules) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers the possibility for refinement in a tier I risk assessment. This includes the refinement of exposure estimates from the screening step and also additional exposure routes, such as the exposure to flowering weeds in field and field conditions. According to the new “EFSA Guidance Document on the development of a whole colony (3 replicates, untreated) are compared to the results were 200 cells per hive were implied. The parameters compared are: BTR, brood and compensation indices.

TU043
Higher-tier risk refinement of solitary bees in the field - is the well-known ‘focal species’ concept a suitable approach? J. Lueckmann, M. Faupel, J. Ludwigs, Rifcon GmbH According to EFSA (2013) bumble bees and solitary bees have to be considered in addition to 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 bees 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 ICPBPR bee brood working group and AG Bienenschutz to improve the method, several semi-field studies have been conducted. The central endpoint in these higher tier studies is the colony reproduction success (production of young queens). As the evaluation of historical data from field and semi-field studies have shown that exposure of solitary bees have already been tested for years. Currently, an ICPR Non-Apis working group is developing a standardized method for semi-field studies with bumble bees. Based on the protocols of the ICPBPR working group, several semi-field studies have been conducted. The central endpoint in these higher tier studies is the colony reproduction success (production of young queens). As the evaluation of historical data from field and semi-field studies have shown that exposure of solitary bees have already been tested for years. Currently, an ICPR Non-Apis working group is developing a standardized method for semi-field studies with bumble bees. Based on the protocols of the ICPBPR working group, several semi-field studies have been conducted. The central endpoint in these higher tier studies is the colony reproduction success (production of young queens). 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solitary 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 ECOPA company data evaluation

A. Dinter, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. W. Schneider, BASF SE; 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 / Innovating Environmental Sciences; L. G. Ehrke, ECOPA

A preliminary data evaluation was conducted by ECOPA companies to compare the sensitivity of bumblebees (Bombus terrestris) with the sensitivity of honeybees (Apis mellifera). For the evaluation about 50 data sets were available for contact exposure and about 50 data sets for oral exposure. The data sets comprised insecticides, 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 negative impact on bumblebees at the maximum intended use rate. Overall, the EcOPA 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, Environigo, 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 regulators to monitor and regulate products 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 honeybee 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 within 10 days in individual cages for a period of 10 days. During the exposure phase bumblebees are kept individually in cages – “single housing”. Bumblebees do not share food via trophallaxis and need to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen-less BB workers) potentially introducing mortality. Mortality and behavioral abnormalities in the test groups were observed and recorded daily and compared to the untreated control groups. The endpoints calculated were: LC50 (median lethal concentration) and LD50 (median lethal dietary dose) values after 10 days and if possible the NOEC (no observed effect concentration) and NOEDD (no observed effect dietary dose). First results indicate that with this method reproducible results were obtained. The mortality in the control groups seem not to exceed 15 % (evaluation currently ongoing) and the overall food consumption allowed for a proper evaluation of the intended endpoints.

TU046

Standardization of method to test toxicity on stingless bees

T. Roat, EAS Ecotox GmbH / Ecotoxicology; O. Malaspina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Biology; R. Nocetti, UFSCar / Departamento de Ciências da Natureza Matemática e Educação; O. Malaspina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais

Brazil is the country with the greatest diversity of bees in the world. The Brazilian bee fauna consists of 5 families: Andrenidae, Apidae, Colletidae, Halictidae, and Megachilidae. These species are polylectic and can forage on a huge diversity of foods. There are three subfamilies: Xylocopinae, Nomadinae, and Apinae. The subfamily Apinae comprises 19 tribes, among them the Meliponini, commonly known as “stingless bees”. In honey bees, a bee’s diet consists of 3 basic components: water, pollen, and nectar. These components are eaten together and provide the necessary nutrition for the bee’s survival. However, stingless bees are much more diverse in their diet and can forage on a huge variety of foods, including foods that are toxic to honey bees. This diversity makes it difficult to study the toxicity of substances to stingless bees. In this study, we used a honey bee assay to test the toxicity of common agricultural chemicals to stingless bees. The results showed that stingless bees were more sensitive than honey bees to some chemicals, but less sensitive to others. Overall, the study indicated that stingless bees are a promising model system for studying the toxicity of substances to pollinators.
termination rate during the larval development as well as the success of emergence of their progeny (F1-generatior) in the following years. Based on the results of the ring-tests 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.

**TT049**
Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach
T. Pamminger, BASF SE, Agrarzentrum Limburgerhof / Ecotoxicology; N. Hintermair, BASF SE / Ecotoxicology. C.W. Schneider, BASF SE; I.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 have been emerged as an intensively discussed topic. In current risk assessment methods are required to be pure exposure surrogate in pollen and nectar 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.

**TT050**
New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experiences
M. Persiizehl, 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 relating to pesticides, there is an increasing need to develop robust methods to adequately determine residues of aspart from (semi-) field studies with bees in pollen, nectar and honey, studies on foraging behaviour as well as methods to adequately determine residues for non-standard uses, such as home and garden uses, ornamentals and granules with a slow release formula. The different methods are compared and advantages and potential pitfalls are illustrated.

**TT052**
Normative Instruction 02/2017 - Brazilian risk assessment of pesticides to bees F. Viana-Silva, C. Dias, L. Borges, K. Cham, C. Tonelli, R. Oliveira, A. Alves, IBAMA / DIQUA CGASQ; R. Rebolo, IBAMA / CCOPN
Generally there are increasing concerns about possible decline in pollinators which requires that efforts be made in the direction of identifying its possible causes and in establishing policies for protecting pollinators. The Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) is responsible for environmental assessments in the context of pesticide registration in Brazil. Since 2011 IBAMA is implementing the risk assessment of pesticides in Brazil and one of the most challenging tasks is the determination of residues of aspart (semi) field studies with bees in pollen, nectar and honey, studies on foraging behaviour as well as methods to adequately determine residues for non-standard uses, such as home and garden uses, ornamentals and granules with a slow release formula. The different methods are compared and advantages and potential pitfalls are illustrated.

**TT053**
How the new Brazilian risk assessment framework for bees works K.d. Coelho, ADAMA BRASIL / Regulatory Affairs; G. Weyman, ADAMA
The Environmental Assessment of pesticides in Brazil is performed by the Environment and Renewable Natural Resources (IBAMA) and comprises three different tiers: Environmental Hazard Potential Assessment and Environmental Risk Assessment. The hazard assessment has been established since 1990 but the Risk Assessment, although required since 1996, only started to be implemented by IBAMA in 2012 and has been developing further since then. Due to numerous global discussions on the decline of pollinators, in February 2017 IBAMA published the first ruling (“normative”) to establish guidelines, requirements, and procedures for a systematic risk assessment scheme of pesticides for pollinators in Brazil. Further guidance for the scheme was issued later in 2017. The Brazilian overall approach is similar to EPA, but there are nuances in the Brazilian scheme regarding which active ingredients must be tested, and additional considerations for future which must be understood. Using hypothetical data from a mixture and a single pesticide, we will show how the above mentioned “(normative)" works for two use patterns, foliar and soil application, considering the main aspects of Tiers 1 and 2 of the risk assessment. Furthermore, the main points of this Brazilian risk assessment framework for bees will be compared with those adopted by other countries, considering both similarities and differences. Keywords: Pollinators, bees, risk assessment, Brazil

**TT054**
An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan Y. Kameda, Chiba Institute of Technology / Creative Engineering; E. Fujita, K. Tachibana, Chiba Institute of Technology
Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, Acetamiprid, Thiacloprid, Clothianidin, Dinotefuran, Thiamethoxam and Nit pymram are popular. Their usage began from the beginning of 1990 and is increasing till 2008 in Japan. Recent annual total usage of seven insecticides is not increasing, approximately 400 tons per year in Japan. Nevertheless, their potential off-target effects on managed (e.g. Apis mellifera) and non managed (e.g. Apis bee species) have emerged as an intensively discussed topic in current risk assessment procedure of PPPs in Brazil. How they affect the survival of honey bee colonies is currently the discussed in Japan. The aim of this research is to reveal ecological risk assessment of honeybees including colony survival in Japan by ELISA analytical methods. The exposure assessment is conducted by neonicotinoids residue concentrations in adult honeybees, pupae, pollen and honey. These samples were collected from beekeepers around in Japan. Information about condition of colonies was also collected from beekeepers. Wild honeycombs were also collected. The six neonicotinoids were detected in all samples including honey, pupae and adults. Especially, more than ten times higher concentrations were detected in some of honey bee samples than those reported by previous reports in Europe, Canada and America. All colonies where adult honeybees were exposed by high concentrations were evaluated as abnormal condition such as CCDs, massive fatalities and sacbrood disease. Moreover, possibility of abnormality of colonies was strongly dependent on residue concentrations in adult honeybees. It was very interesting that EC50 values of colony abnormality, derived from this epidemiological research, were not much different from LC50 of adult bees. The values and the ELISA screening techniques could be one of easy warning values for beekeepers which indicate possibility of colony abnormality.

**TT055**
Thiamethoxam Honey Bee Large Scale Colony Feeding Study - Design and Interpretation N. Ruddle, Syngenta Ltd / Product Safety; H. Thompson, Syngenta Ltd / Environmental Safety; K. O’Grady, Syngenta Crop Protection Ltd / Environmental Safety; C. Elston, Syngenta Ltd; M.A. Feken, Syngenta / Ecological Risk Assessment; S. Bocksch, Eurofins AgroSciences Ecotox Gmbh / Ecotox Honeybees; P. Thorbek, Syngenta / Environmental Safety; M. Hill, Eurofins AgroScience Services Inc
Colony feeding studies were originally developed to directly assess the insect growth regulating properties of neonicotinoids and designed to determine mode of action rather than effect levels. More recently there has been regulatory interest in conducting colony feeding studies to determine the pesticide level in nectar substitute (sucrose solution) which leads to colony-level effects, thereby allowing

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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 transient differences for pollen stores, overall colony strength and overwintering survival were similar to the control, confirming the NOAEL as 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 on-going 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 crops to residues of thiamethoxam in pollen and nectar of seed treatment schemes that are an order of magnitude lower than the no effect level observed in this study.

TU056 Alteration of the alternative splicing pattern in honeybees’ nervous system gene products as a tool to test pesticides toxicity
P. Decio, P. Karsch, L. Jeker, Swiss Bee Research Center / Agroscope; V. Christen, 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 a set of genes in the brain of honeybees. Previous studies have shown that the knockdown of a single gene can result in a clear pattern on polyacrylamide gels. It was not possible to observe a differentiated pattern of these, however, can realistically be used only based on relatively few individual bees. The measurement of effects on colony size as a whole can be expected between 2 bees 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 numbers of honeybees should be considered and discussed in order to minimize the toxicological endpoints, bees were orally exposed to different sub-lethal concentrations of thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/bee, 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/bee, 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 1 ng TMX/bee, was significantly lower with ten bees compared to the two bees approach. A large variability of sucrose rate and gene expression during treatment runs was found 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 numbers of honeybees should be considered and discussed in order to minimize the toxicological endpoints.

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, 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. 2016) 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/bee, 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/bee, 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 1 ng TMX/bee, was significantly lower with ten bees compared to the two bees approach. A large variability of sucrose rate and gene expression during treatment runs was found 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 numbers of honeybees should be considered and discussed in order to minimize the toxicological endpoints.

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 most 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 honeybee 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 95th 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
A. Görlich, WSC Scientific GmbH; M. Wang, WSC Scientific GmbH / Dept Efate Modelling; J. Kleinmann, A. Görlich, WSC Scientific GmbH For honeybee semi-field and field studies EFSA defined 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 service 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 higher bee developments, 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 at 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 tradeoffs 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, further 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 / Department of Pure and Applied Chemistry; P. 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 can 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 metropolis, Nigeria. Chevon and beef samples of heart, intestine, liver, muscle and tripe were collected from both sexes of two breeds of cattle and West African dwarf goats. Raw and cooked samples were digested and analysed using the method described by the Association of Official Analytical to determine the levels of the metals by Atomic Absorption Spectrophotometric technique. Results show that there were significant differences (<0.05) in the concentrations of the metals in the different parts and 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-limit concentrations are observed more in the varieties 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 using masked samples when compared with raw samples for all the metals analysed. From the various data obtained, it can be concluded that all the 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

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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 antioxidan system (catalase [CAT] and superoxide dismutate [SOD] activity), an enzyme of detoxification metabolism (glutathione S-transferase activity [GST]) as well as acid phosphatase [AP] activity and lysosomal membrane fragility of coelomocytes (neutral red retention time, 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 to 2-28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 28 days and correlated to SOD currently to the male sex. For Bi, Co as metallogenic parameters including the production of alloys and munitions formulations and as a complete impairment in reproduction at 56 days. These results are revealing of early sub-letal biological alterations in connection to contaminant toxicity and bioavailability. Bioaccessiblility bismuth (Bi) concentrations (using KNO3, soil extraction) were correlated to SOD activity and suggest an important contribution to the overall toxicity. Bi is used increasingly to replace lead in several industrial applications including the production of alloys and munitions formulations. However, little information is available on the environmental fate and ecological effects of Bi. This paper also summarizes the acute toxicity (LC50=416 mg Bi/kg ) and biacessibility of Bi, and describes bioavailability and chronic effects of bismuth on the earthworm Eisenia andrei. In reproduction tests, adult earthworms were exposed to natural sandy soil spiked with Bi citrate. Results indicate that Bi concentrations lead to a decreased rate of earthworm's growth and in a concentration of 75 mg Bi/kg and 0.005 mg bioaccessible Bi/kg. Bismuth had little effect on phagocytic efficiency of adult earthworm coelomocytes. After 28 days,Bi concentrations in earthworm tissue increased up to 21.2 mg Bi/kg and reaching a stationary state at 212 mg Bi/kg of soil.

TU064

Assessment of subcellular metal-binding ligands in white suckers (Catostomus commersonii): are all the metals accumulated in the heat-stable fraction (HSP) detoxified by binding to metallothioneins?

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Heavy metals are known to be toxic to living organisms and can affect the health of aquatic organisms. They can be accumulated in the cells of these organisms and can lead to harmful effects. Metallothioneins (MT) are known to be involved in the detoxification of heavy metals. However, the exact mechanism of their action is not well understood. In this study, we aimed to assess the subcellular distribution of heavy metals in white suckers (Catostomus commersonii) and to determine if they are detoxified by binding to metallothioneins.

We used size exclusion chromatography coupled to an inductively coupled plasma mass spectrometer (SEC-ICP-MS) to separate biomolecules present in the HSP fraction and to quantify the associated metals. 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 MT binds these metals. Furthermore, we observed a second peak at 25-27.5 min, which corresponds to a different metallothionein.

We also performed a toxicity test to determine the potential of these ligands to bind metals. We observed a decrease in the hsp fraction of the exposed fish compared to the control fish, indicating that the metallothioneins are still present in the exposed fish. Furthermore, the analysis of the HSP fraction revealed the presence of metal-binding ligands such as metallothioneins (MT) and metallothionein-like peptides (MTLP). Metallothioneins are known to bind metals, but their exact role in the detoxification process is not well understood. In this study, we observed that MT and MTLP are involved in the detoxification of heavy metals in white suckers.

In conclusion, our results indicate that metallothioneins are involved in the detoxification of heavy metals in white suckers. This is important for understanding the mechanisms of metal detoxification and for developing strategies to reduce the impact of heavy metals on aquatic organisms.
chronatography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb>Cr>Cd>Cu>Ni. The HPI and MI values were far above the critical values. Results also showed EDCs to include PAH, phthalates, PCDDs, PCDFs, PBDEs, bisphenol A and PCBs. This study established that Onitsha stretch of River Niger contains varying concentrations of heavy metals and EDCs. The stretch of that river is highly polluted, and anthropogenic activities are highly impacting negatively on the river. Therefore need to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

TU066

Bioaccumulation, DNA damage and metallothionein expression in plants grown with heavy metal contaminated soil supplemented with sewage sludge

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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. 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 metallurgical 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 levels of MT was observed in plants grown under metal stress. The differences showed statistically significant changes between related conditions which means that presented assay can be used as a sensitive stress marker for phytoremediation process.

TU067

Chronic toxicity assessment of Ni contaminated rivers in Japan using Ceriodaphnia dubia for development of biotic ligand model for Japanese surface waters


Ni is one of industrial essential chemicals and have 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 separately, and each was based on the characteristics of the water (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 original BLM based on the data of Japanese surface waters. To collect Ni toxicity data in surface waters, we collected 45 river water samples from Ni contaminated rivers all over Japan and conducted the daphnids reproduction test using 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 (WHAM7) for speciation calculation. Ni toxicity were 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

Comparing metallic element in corals from South Africa and the Marsecara Basin

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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 skeletons 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 5 sites in the WIO. Sodwana and Alivä Shool constituted the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Marsecara basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected oceanic sampling sites. Eighty-one 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 Marsecara 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. 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 sp. from SRR 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 in South Africa. Corals from the WIO contained significantly higher concentrations of all elements 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.

TU069

Cytochrome P450, fat and ageing: new insights into metal toxicology

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Toxic metals are among the most persistent environmental pollutants worldwide and have been implicated in metabolic disorders, including diabetes, obesity and neurological diseases. Long-term exposure to metals increase the susceptibility of healthy individual to hematological and developmental disorders. Several genetic markers including metallothioneins, heat shock proteins and oxidative stress related genes have been used to analyse the response to metal stress. Other biomarkers for metals include cytochrome P450 (CYPs) a class of xenobiotic metabolizing enzymes that can transform compounds to either non-toxic or carcinogenic metabolites. Studies have shown that CYPs can metabolize important fatty acids and regulate lipid metabolism. Both CYPs and fatty acid metabolism have been implicated the ageing process and lifespan regulation, however the mechanism has not been fully understood. Currently there is a need for a comprehensive robust model to study stress response mechanisms induced by metals due to some functional similarities with humans. Our aim was to study the mechanism behind the metal induced CYPs and fatty acid metabolism alterations leading to regulation of lifespan in C. elegans. Transcriptomics, viability, lifespan, gene expression analysis and RNA interference were used to explore the interaction between the CYPs, fatty acid metabolism and lifespan of C. elegans following metal exposure. C. elegans were exposed to metal contaminated environmental sample and lab reconstituted 12 metal mixture during post hatching larval stages (L1 to young adult). Transcriptomic analyses showed upregulation of cyp-33A1, cyp-35B1 and cyp-35B2 genes on exposure to both the metal mixture and environmental sample exposure but the upregulation was above 15 fold in the metal NON-GC exposed nematodes. Fat staining with Nile red also showed significant increase in the level of stored fats on metal mixture and environmental sample exposure. Further, fatty acid metabolism related genes such as fasn-1, pod-2, acs-2 and fat-5 were also altered on exposure to both the metal mixture and environmental sample. Our results show that metal alters the CYPs and fatty acid metabolism and can have functional implications on the lifespan of C. elegans. Understanding the interplay of CYPs and fatty acid metabolism can unravel possible mechanisms of metal induced onset of several diseases and their detrimental effect on the longevity of exposed individuals.

TU070

Determination of the effects of platinum in the oyster (Crassostrea gigas) using cell and tissue level biomarkers

R. MEDRANO, University of the Baque Country; M. Abdou, UMR5805 EPOC / Geochemistry; M. Soto, University of the Basque Country / Zoology and Animal
Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIEUP/HEU; U. Izaguirre, 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; J. Schäfer, Université de Bordeaux; B. Zaldibar, University of the Basque Country UPV/EHU / Department of Zoology and Animal Cell Biology, Centre of Experimental Marine Biology & Biotechnology Platinum (Pt) is a trace metal that is known to be a potential neurotransmitter, but its neurotoxic potential remains uncertain. The present study addresses the effects of Pt on the Japanese oyster (Crassostrea gigas) at low levels of organization, such as cellular and tissue. For this, oysters were exposed to different Pt concentrations (Control = 0 ng·L⁻¹; Low = 50 ng·L⁻¹; Medium = 100 ng·L⁻¹ and High = 100 µg·L⁻¹) for 3 (T3), 7 (T7) and 28 (T28) days. The condition index of each individual was calculated as well as the gametogenic development stage. In addition, the histopathology of the oysters’ digestive gland was studied, including atrophy levels, tissue structure and parasite prevalence among other anomalies. Different histochemical parameters such as lipofuscin and neutral lipids were also measured and combined with autometallography to detect the location and quantity of Pt. An increase of autometallographical black silver deposits was observed, which can lead to an increase in the protein turnover and activity. However, for the other study metal, Pb, any positive, biological function has not been observed. All tests were run in transparent microplates (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 medium (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 72hours were 140, >1200 and 293 µg·L⁻¹ for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 214 and 134 µg·L⁻¹ respectively and in BBM, they were >300 µg·L⁻¹ in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg·L⁻¹ 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/073 Environmental diagnosis of water and tilapia Oreochromis niloticus of the Tenango dam, Puebla, Mexico.

M. M. Munoz-Najera, G. Barrera Escrigue, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia; P. Ramirez Romero, V. A.M. Iztapalapa / Hidrobiologia Human population has seen the deterioration of resources derived from its overexploitation and contamination by anthropogenic activities, an example of this is water. Due to the growing demand for this resource, associated to its population growth, industry, livestock, and agriculture, dams have been built to satisfy these needs. In Mexico, some of them were constructed in sites where over time were declared protected natural areas. Populations have settled on its banks to make use of the water, as well as of the organisms linked to these aquatic bodies, which represents economic sustenance for the inhabitants. On the other hand, it is common to use the water for various purposes, many of which contradict each other. Such is the case of the Tenango Dam, in Puebla, México, which is used for fishing, irrigation, recreation and electric power generation, among other purposes. A study was made to evaluate the ecological status of this place and its biogeochemical cycle increasing its presence in many natural compartments. Oysters have been widely used as sentinel organisms in environmental monitoring programs for decades because of their sedentary way of life and ability to accumulate pollutants with little metabolic transformation. The present work addresses the effects of Pt on the Japanese oyster (Crassostrea gigas) at low levels of organization, such as cellular and tissue. For this, oysters were exposed to different Pt concentrations (Control = 0 ng·L⁻¹; Low = 50 ng·L⁻¹; Medium = 100 ng·L⁻¹ and High = 100 µg·L⁻¹) for 3 (T3), 7 (T7) and 28 (T28) days. The condition index of each individual was calculated as well as the gametogenic development stage. In addition, the histopathology of the oysters’ digestive gland was studied, including atrophy levels, tissue structure and parasite prevalence among other anomalies. Different histochemical parameters such as lipofuscin and neutral lipids were also measured and combined with autometallography to detect the location and quantity of Pt. An increase of autometallographical black silver deposits was observed, which can lead to an increase in the protein turnover and activity. However, for the other study metal, Pb, any positive, biological function has not been observed. All tests were run in transparent microplates (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 medium (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 72hours were 140, >1200 and 293 µg·L⁻¹ for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 214 and 134 µg·L⁻¹ respectively and in BBM, they were >300 µg·L⁻¹ in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg·L⁻¹ 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/074 Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipsticks in Nigeria. O. P. Ojeifo, Federal University of Agriculture, Department of Biochemistry; A.C. Udebanju, Federal University of Technology / Department of Biotechnology; T. Oritoju, University of Nigeria Nsukka / human nutrition and dietetics

Heavy metals have been implicated as a causal factor in literally any health problem including infertility and cancer. Their presence in most cosmetic products may pose more harm than envisaged. Lipsticks are common beautifying cosmetics used by young women. The study of the risk of exposure to heavy metals from lipsticks among users and also to evaluate target cancer risks due to its use. This study was carried out in Wukari, Nigeria, samples of different lipsticks and lip glosses of many colours and texture were collected and analyzed for heavy metal contents (lead, Arsenic, Chromium, Cadmium and Mercury) using Atomic Absorption Spectrophotometer (AAS). The result of the mean concentration of the heavy metals are as follows; Lead, ranges between (2.65-7.40 ± 0.17) mg/kg;
heavy metals in vegetables were generally higher in summer (ranging from (nd – 116.26 μg/kg) than in winter (ranging from (nd – 144.28 μg/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 showed higher accumulated pollution concentrations 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
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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 genomic absorption, and therefore arsenic-associated toxicity in highly exposed people, through a dietary intervention with naturally high selenium lentils. This treatment is especially practical for populations already consuming lentils on a daily basis, as in the region notorious for chronic arsenic poisoning, the Indochinese 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 through 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). Summary: This study demonstrates the potential effectiveness of a simple, whole food solution of consuming lentils naturally high in selenium to reduce absorption of arsenic from water and food.

Tu078

Metals removal from water for hazard classification
G. Burton, 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 or dissolved form. It is important to understand the initial fate of contaminants in aquatic environments, partitioning, speciation and resulting biological effects. In addition, current European Union regulations and the global GHS system mandate a hazard evaluation, which includes the assessment of Rapid Degradation (greater than 70% within 28 days), which for metals equates to metal removal from the water column. The Transformation/Dissolution Protocol (OECD 29) is an established method that was modified to examine metal removal from the water column under anoxic conditions. The modifications include the addition of a small amount of sediment, and the inclusion of a resuspension event. We conducted a series of laboratory evaluations to address the following questions: Are copper (Cu) and nickel (Ni) removed from the water column of freshwater systems and if so, what is the rate of removal? How do various test conditions affect metal removal, using OECD method 29? What sediment characteristics affect metal removal and which show a reasonable worst case condition (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-removal rates of metals included dissolved Cu, Ni, and Fe, dissolved oxygen (DO), pH and AVS-SEM of sediments. Multiple dried or non-dried sediments were tested in batch reactors for both 96 h and 28 d 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 of 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 Schampheelaere, 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 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 tested were used and compared 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 Systems
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 self-seeded capping materials 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 AquaBlok, limestone, and limestone + bonechar. Experimental field tests implemented novel methodologies, using Luminocorals (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-acclimatering 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 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 REEchangE - Rare Earth Elements Ecotoxicology in a Changing Environment
H. Tien, Hamburg University of Applied Sciences/University of the West of Scotland; S. Heise, University of the West of Scotland; H. Winter, University of the West of Scotland
REEchangE 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 inclusions 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 REEchangE addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxic responses obtained for Alivibrio fisheri and Rhaphiodoncillus subcapitata so far are in the same range as literature data, and show a higher toxicity of Gd compared to La. Effect concentrations are one 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 were 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 new 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, North-West University School of Biological Sciences / Zoology
Sediment characteristics generally entail metals, minerals, organic content, elements, particle size distribution and quality. The origin of metals in sediments 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 Mokopo river in South Africa. South collected sediment samples from the subsubstratum 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 AFI Quantas 250 FEG ESEM microscope equipped with an integrated Oxford Inca X-Max 20 EDS. Macroinvertebrates present in the benthos were collected for 15 minutes using a standard sweep net, preserved in 90% ethanol and identified up to family level. RDA redundancy analysis was constructed to investigate the distribution of macroinvertebrates Forty two families of which the vast majority associated with particles >2000µm, were found. Sediment particle sizes < 2000µm had a detrimental effect on the biodiversity. No significant correlation was demonstrated between the influence of the electrical conductivity and both diversity and abundance of macroinvertebrates. Although relatively high concentrations of selected metals were present in the sediment, it was largely from geological origin and most probably not bioavailable. Therefore, it can be concluded that, under these conditions, sediment particle size, played the decisive role on the distribution and abundance of macroinvertebrate taxa.

TU083 The effect of copper sulphate on the antioxidants enzymes activity of two size classes of Cerastoderma edule
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Cerastoderma edule is a bivalve species, which is 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 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 tested were used and compared 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.
through thiobarbituric 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 at low environmental risks of metal-contaminated systems remains an important challenge. While 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, Cryptocercus riparius with different Phrygiana, SO soils with El 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 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. pH2O/20 and pH2O/Pb decreased with increasing total Pb concentration for most soils, but pH decrease was much stronger for the soils with lower CEC and OC content. Sorption of Pb from the CaCl2 extracts could be well described by a Freundlich isotherm (R² = 0.96-0.99) and Freundlich sorption constant Kp increased linearly with increasing cation exchange capacity (CEC) (R² = 0.86) or organic carbon content (OC) (R² = 0.76). Pb bioaccumulation in the enchytraeids was soil-dependent, but differences between soils almost disappeared in correlation with the recorded concentrations of dioxins in 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 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 unknown 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 (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; 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, Public Health, University of Milan and Italy, together with the Wageningen University and Research Centre of Vrâtei and Wageningsen -NL-, worked on a data collection project commissioned by the European Commission, Safety Authority (EFSA). The aim of the project was to investigate the comparability of the EC, 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 EC₅₀ or EC₉₀ as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depends on the experimental study design, whereas EC values are considered more appropriate to measure the way 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 EC₅₀, EC₉₀, and ECquant 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 TiO₂ and CeO₂ 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. Veiga, Universidad de Cádiz; J. Cruz, Instituto Agroalimentario / Environment; E. Conde, CIEMAT; J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment; F. Torrent, Universidad Politécnica de Madrid / Escuela Superior de Ingenieros de Montes; D. Hernandez-Moreno, INIA / Environment

In the framework of H2020 Project GuideEcano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on 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 CeO₂ NPs and TiO₂ NPs of 4-8 nm uncapped 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 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 TiO₂ NPs. A difference was observed for the uncapped NP 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 a very fast elimination 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 CeO₂ NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO₂ NPs uncapped or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO₂ NPs. These results indicate a different behavior for the CeO₂ NPs and TiO₂ NPs. No relationship could be observed between the coating and the observed effects.

**TU090** Colloidal characterization of nano-enabled products for the restoration of works of art: environmental fate of nano-shells

E. Hernández-Cruz, Universidad de Vigo / 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 Sciences, Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice; E. Galante, INIA - National Institute for Agricultural and Food Research and Technology / Environment; A. Volpi Ghirardini, University Ca Foscari Venice / Department of Environmental Sciences Informatics and Statistics; C. Giuliani, G. Di Carlo, CNR ISM; 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 biomarkers as well as their rapid uptake and 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 framework of the H2020 Nano2020 NANOGEN project, we are investigating innovative nano-enable formulations for the conservation and restoration of modern and contemporary artworks that have been provided, following a Safe-by-Design (SbD) approach. The safety of the new formulations was investigated by applying both EU CLP self-classification approach for mixtures (ECHA, 2017) and experimental in vivo and in vitro ecotoxicological tests. In order to better understand the key interactions occurring between ENM and the biological medium, in the context of the tests, 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).

**TU091** Considerations for Safe Innovation: The Case of Graphene

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In the framework of FP7 Project GUIDEnano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on 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 CeO₂ NPs and TiO₂ NPs of 4-8 nm uncapped 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 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 TiO₂ NPs. A difference was observed for the uncapped NP 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 a very fast elimination 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 CeO₂ NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO₂ NPs uncapped or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO₂ NPs. These results indicate a different behavior for the CeO₂ NPs and TiO₂ NPs. No relationship could be observed between the coating and the observed effects.

**TU092** Safer-by-design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine

M. Schnatz, C. Soni, EMFA Technology & Society Lab

One of the hot topics in nanomedicine is the use of nanobiomaterials for drug delivery. On the one hand, nanobiomaterials have various expected advantages compared to its bulk material: 1) decreased doses, 2) possibility to cross biological barriers, 3) increased drug efficacy, 4) reduction of side effects, and 5) targeted drug delivery. On the other hand, the nanosize brings new challenges for risk assessment. “Safe innovation” and “Safe-by-design” are terms popularly referring to the goal of considering safety aspects already at an early stage in the innovation process of (nano)materials and nanoeabled products. We specifically look at the case of Graphene and investigate the possibilities of considering safety aspects during various stages of the innovation process. Based on this we suggest that in the first stages a clear description of the production processes and substances involved are needed in order to support a potential future for use. After that the standardization of the production process becomes important in order to reach a more reliable exposure assessment and enable use of exposure reduction measures where needed. Furthermore we outline what information on graphene is already available for assessing potential human and environmental hazard, exposure, and risks. For example a first indication of the hazard of an (intended) product can be obtained by collecting information on a limited number of physicochemical properties of the intended grapheneproduct: dimensions, shape and surface properties. In addition, we recommend further steps to be taken by various stakeholders to promote the safe production and safe use of graphene. We emphasize that a safe and time-efficient innovation process is only possible under the conditions of clear and timely communication between innovators, scientists, risk assessors and regulators.
risk of 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 nanomaterial-specific guidelines and recommendations. 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 toxicity and environmental assessment

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; J. Sh repellent and hydrophilic.

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 were chosen to make 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 scope (excluding the environmental impacts of material and biomass feedstock production) and 2) omission of some environmental aspects relevant to bio-based materials and products, as well as the end use phase. 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 hydrocarbon 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. Stolle, 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 (acetylcholine esterase), cell lines (IPC-81), bacteria (Vibrio fischeri), algae (Raphidocelis subcapitata), freshwater plants (Lemna minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinaldine, ethyl lean alkylcarbazoles due to the order of gL. The over results indicate that 2-Octanone 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 “Tailor made fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

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.

The 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 bioanalytical 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 embryotoxicity 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 two biofuel derived fuel candidates: 2-Octanone 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.

TU096 Investigation of the toxic effects of new mixtures of deuterated fuel solvents on fish and on the environment and human health

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The development of environmentally benign and green synthetic protocols, due to the concern over carbon footprints, has brought to the necessity to find greener, readily biodegradable and low cost solvents. This new concept of green chemistry has recently led to the synthesis of Ionic Liquids (ILs), from which have evolved in few years the deuterated solvents (DESes).[1] These compounds are obtained mixing two components: a quaternary ammonium salt (e.g. ChCl) with different hydrogen bond donors, in such a ratio that the resulting substance has a significantly lower melting point than that of each individual component. DESes have proved to be environmentally sustainable and alternative to the conventional organic solvents in synthetic chemistry, able to increase efficiency of organic transformations. These solvents have attracted widespread academic and industrial interests, and have found almost unanimous worldwide approval. Cosmetics has “leaped 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 DESes, 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 DESes contain nitrogen (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 presented as gels, meaning that they could be a new type of soil additive. Toxicological studies on ChCl+Glycerol and ChCl+Levalinid Acid (never before studied) on algal 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, is indeed not affected by all the tested compounds in the order of gL. Results from the present study indicate an expected safer

New frontiers in Life Cycle Inventory data collection and modelling (P)

Predicting environmentally beneficial production pathways for chemicals with neural networks
J. Klünnkemper, 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.

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 trends 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 2000 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 registration 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 LCI 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.

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 reporting of 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 factor well as all technical choices made when implementing the 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 website. Among the above mentioned changes the most relevant ones 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, duplicated or useless flow properties have been deleted and mapped to the remaining ones - 35 unit groups have been deleted, one new has been created.

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 2013 and improved after the official launch of the LCDN (2014). All those tools were originally meant for the International Life Cycle Data (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 allows to register 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 schematics, 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.

Improving the consistency and the accuracy of water inventories of chemical sites in PlasticsEurope LCIs in the perspective of the applicability of the impact assessment method PERFORM. M. Baier, 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 inconsistencies in its eco-profiles (even where use and consumption sometimes were somehow connected to this short term action, in perspective of enabling the application of the latest consensus 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 water use in a chemical plant and the link to the life cycle inventory phase and ILCD flow names. This presentation uses 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 gate 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, INSa Toulouse / LISPB; Y. Pigné, Université de l’Havre; T. Navarrete-Gutiérrez, LIST; N. SCHIOPU, A. Lebert, CSTB; T. Gibon, Luxembourg Institute of Science and Technology (LIST)/Environmental Research and Innovation (E RI) tool; T. Boulet, Luxembourg Institute of Science and Technology (LIST)/Environmental Research and Innovation (E RI) tool; 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 not negligible impact on 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://dyplca.pigne.org/), aiming at calculating 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 temporal LCI, i.e. 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 clinging on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic LCI is an opportunity to grasp more insights into the 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 Economics IRL; J. Godar, Stockholmsmiskollegiet

That location matters when it comes to quantifying environmental impacts of agricultural products is proven by the increasing number of case studies within 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 arena to computationally run at these impacts, this usually 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 from farm to gate, for which LCI data is not frequently available. The Trase platform allows for real-world pathways of several internationally traded commodities to be annually mapped, from producing regions to destination countries. In view of its great potential for LCA purposes, our goal is to implement a carbon footprint module able to deliver results on CO2-eq. emissions associated, on the one hand, to annual production of soybean supplied from Brazil for the period 2010-2015; on the other hand, to every individual supply chain embodied in 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 LCA (especially that adopted at Trase) for further study of 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.

**TU104**

**Carbon Footprint Projections for Japan Using Computable General Equilibrium Model**

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 will 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 life cycle chain. On the other hand, the IAM focuses on the technological and industrial processing data and normally don’t include the dynamics of system. Therefore, this study aimed at the development of a dynamic evaluation of environmental impact method based on life cycle thinking to use both advantages of IAM and LCA. Currently, we try to develop the database using AIM developed by the National Institute for Environmental Studies (NIES). This model uses Computable General Equilibrium (CGE) which can estimate economic efficiency in the future, based on price mechanism in the market. In this study, we collect fundamental data using LCA database and estimate GHG emissions in the future considering the supply chain among industrial sectors. We estimated GHG emissions in 2005 as a tentative result in Japan. The total emission is approximately 1.13E+08tCO2-eq. We confirmed the validity compared with the existing report published by the ministry of the environment in Japan. In the future, we will estimate environmental impact projection considering the scenario like Shared Socioeconomic Pathways (SSP).

**TU105**

**Network LCA as a tool to enhance data collection and usage in a value chain and industrial processing**

H. Havre; T. Navarrete; T. Tuominen; M. Myllysilta, S. Majaniemi, 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 that the inventory analysis is performed followed by the life cycle impact assessment. At the end, the results are interpreted. The inventory analysis includes the product projection. Then, the different changes related to the product analysis. 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 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 bigger than those of the competitors. The idea of network LCA is to tackle all the above mentioned four challenges. The main impact of network LCA is to produce from the confidential source data of a company network level results, e.g. carbon footprint, which may be delivered to all network members openly. At the same time, all the network members can perform a local LCA computation to study their own local footprints. In other words, network members can independently run the impact analysis. The idea of network LCA is to standardize the use current environmental footprints on material choices or manufacturing methods both locally and at the network level. This feature is also beneficial for policy planners who want to see the big systemic picture and formulate their action plan based on the observed data. The data needed for the life cycle assessment can be provided via a web form, which has certain built-in features to speed up the data gathering process. The web form supports predefined parameter lists and it is also possible to add new parameters to the existing lists. Also the compatibility with impact categories such as impact on greenhouse gas emissions or resource depletion is hereby ensured.
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 may be of energy, water, or material flows 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-Langeveld 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, publicly accessible interface through the US EPA terminology services. This research presentation will focus on describing the benefits of the KOS approach and the tools used to build up of a KOS. A user-friendly, public accessible nomenclature system and provide an example application of the KOS to current elementary flow nomenclature. References [1] de Beaufort-Langeveld A, Bretz R, Hischier R, Huijbregts M, Jean P, Tanner T, van Hoof G (2003) Code of life-cycle inventory practice. SETAC Press, Pensacola, FL [2] Edelen A, Ingersen W, Rodríguez C, Alvarenga R, de Almeida AR, Wernet G (2017) Critical review of elementary flows in LCA data. INT J LIFE CYCLE ASS. https://doi.org/10.1007/s11367-017-1354-3 [3] ISO 14044 (2006) ISO 14044: Environmental management–Life cycle assessment–Requirements and guidelines. International Organization for Standardization, Switzerland

TU106
Developing guidelines for elementary flow nomenclature
A. Edelen, ORISE; W. Ingersen, US EPA

Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a Vital hormone inducer? For the low feeding regime, shotgun proteomics identified an increase in digestive gland and gill cell. 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). 3. Results and discussion Our findings highlighted DNA damage and MN induction at radiation doses as low as in 0.1 mGy/d in digestive gland (MN = also in gill) in both species, below the screening benchmark. Furthermore, compared to stay water (OP), marine bivalve (MG) displayed a higher DNA damage (both tissues) across all 3P treatments. This study highlights that a radionuclide activity concentrations in a biological system cannot be predicted by surrounding environmental media (b) with regards to bioaccumulation of waterborne contaminants, whole body measurements may mask the tissue specific nature of radionuclide uptake, and (c) the importance of adopting a multi species, multi biomarker approach when assessing the possible effect of contaminants in the aquatic environment.

TU109
Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a Vital hormone inducer?
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The aquatic environment is the final recipient of anthropogenic radionuclides, 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 3P 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 3P independent of mussel species. In the next set of studies, a suite of biological responses 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). 3. Results and discussion Our findings highlighted DNA damage and MN induction at radiation doses as low as in 0.1 mGy/d in digestive gland (MN = also in gill) in both species, below the screening benchmark. Furthermore, compared to stay water (OP), marine bivalve (MG) displayed a higher DNA damage (both tissues) across all 3P treatments. This study highlights that a radionuclide activity concentrations in a biological system cannot be predicted by surrounding environmental media (b) with regards to bioaccumulation of waterborne contaminants, whole body measurements may mask the tissue specific nature of radionuclide uptake, and (c) the importance of adopting a multi species, multi biomarker approach when assessing the possible effect of contaminants in the aquatic environment.

TU108
Tissue specific 32P accumulation and consequent biological effects in bivalve molluscs
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The aquatic environment is the final recipient of anthropogenic radionuclides, 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).
Integrating natural processes in environmental hazard assessments of the oil sands

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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 refined 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 Parhyale hawaiensis to examine the impact of the 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.

TU111 Genomic DNA methylation level : a stress molecular marker in the species Gammarus fossarum

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Genotoxic evaluation has been developing for a couple decade among ecotoxicological assessment approaches in the aquatic field. It offers some prospect for unscarred and delayed effects on the offspring and the population dynamics (provided genetic mutations affect gametic genome). However, the modification of the DNA sequence by genetic mutation (as a result of primary DNA damage) is not the only impact of toxic substances on the genome. For example, epigenetic effects, defined as hereditary effects on the DNA function, may add up to mediated effects by genetics way. Among these marks, DNA methylation is extremely studied by scientists. As such, it is important to examine epigenetic changes in the context of population level perspective. This provides a complementary approach to effects on the primary structure of the genome for taking into account the time interval between the exposure to environmental contaminants and their effects. This issue is a real challenge in ecotoxicology. Moreover, epigenetic allows improving the understanding of changes of life history traits (reproduction, growth and development). These parameters are suitable for assessing the toxicity and are known to be regulated by epigenetic. Finally, epigenetic could also help better understand the variability of effects related to experimental conditions between the studies. Therefore, epigenetic marks have an innovative nature for the evaluation of environmental risks. In this regard, we have investigated the measurement of genomic DNA methylation level as a stressor in the Gammarus fossarum, a species that is naturally relevant species Gammarus fossarum. First, the basal level was explored by studying the difference of overall DNA methylation between male, female and juvenile. Then, we evaluated the effects of natural factors on genomic DNA methylation level as starvation and exposed to different temperatures (8, 12 and 18°C) for 7 days and 1 month. To know the variability of DNA methylation in populations of Gammarus fossarum, three French populations from the same genetic strain, were studied. Lastly, the epigenetic biomarker response to a chemical stress was evaluated in a field experience. We encaged gammarids of a reference unpolluted station in sited impacted by various human activities. Stemming from a reference unpolluted station in sited impacted by various human chemical stress was evaluated in a field experience. We encaged gammarids of a genetic strain, were studied.

TU112 INVERTOX: Characterising individual metabolomic variability of the freshwater invertebrate, Gammarus pulex

T.H. Miller, Kings College London / Analytical and Environmental Sciences; J. MacRae, The Francis Crick Institute / Metabolomics; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; S. Owen, AstaZeneca / Safety Health Environment; L. Barron, Kings College London / Analytical and Environmental Science

The (pseudo)existence of emerging contaminants and other organic micropollutants in the environment represents a risk for the organisms that are exposed to them. Metabolomics is providing a powerful tool within environmental toxicology to understand the mediation of the exposure scenarios. However, metabolomics is an emerging field and to interpret the use of metabolite data for the understanding of toxicological responses is challenging. We need to know what is ‘normal’. The variability in individual metabolomes for a species, or a ‘background metabolome’ should be established to determine possible condition-related and individual differences that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolite variability in the freshwater invertebrate, G. pulex. Herein, an analytical method is presented for the extraction and non-target analysis of the metabolome in G. pulex. Briefly, a dual phase liquid extraction was used followed by HILIC-HRMS to enable detection and annotation of metabolite features extracted from individual animals. Animals collected from the field were analysed immediately and compared to animals that were extracted after a fixed period of acclimatisation to laboratory conditions. The results indicated that sex, mating stage and acclimatisation period affected the metabolite variability and factors that are likely to influence metabolomic analyses should be investigated to aid understanding of pathways involved in effect-based studies. Furthermore, it may be possible to select ‘background’ animals that are more sensitive to environmental 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 Parhyale hawaiensis to examine the impact of the 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.

TU113 Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river

V. Svana, Helmholtz Centre for Environmental Research Gmbh / Effect-Directed Analysis; M. Krauss, Helmholtz centre for environmental research - UFZ; T. Luckenhach, 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. In our research, 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 Holtemmen (Satumy-Aanholt, Germany). Sites 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 mouling 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 mouling 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.

TU114 Antennae 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. Many ecological studies have demonstrated that P. hawaiensis is able to regenerate its appendages, limbs and tissues after an injury or lost 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 antennae of six months 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 last reading, another pictorial test was done to determine the difference between the initial length (mm) before and after full regeneration. Antenna 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 toxicants to determine their abiotic and invertebrate 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 like a screening test are used in 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; R.G. Syringman, 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. Freshwater ecosystems are affected by a range of water quality and quantity.Numerous pollutants result from these activities, with metals being particularly prevalent in most urban rivers. These pollutants are known to affect freshwater macro-invertebrate communities. In South Africa, SASS5 (South African Scoring System for Invertebrates) is a river health index that studies the invertebrate assemblages within specific riverine microhabitats, and can assist in shaping the relationship between water quality and macro-invertebrate communities. The Olifants River in the Western Cape, is not only recognized as a hotspot for freshwater biodiversity, but seen by many, until the previous decade, to be the last pristine river along the South African coastline. It is also one of the three main feeding rivers to the City of Cape Town for fresh water. Despite increasing urbanisation, the last State-of-Rivers Report for this river was published in 2006. It has therefore become crucial to investigate the current degree of pollution within this river, as well as the general integrity of the system. This study aimed to determine the degree of metal pollution along the length of the Olifants River, as well as to investigate the effects of pollution and land use on the invertebrate communities, using SASS5. Water and sediment samples were collected seasonally at 5 sites from upper to lower reaches, acid digested and analysed with an ICP-AES for metal concentrations. Invertebrates were also sampled seasonally, identified and scored according to SASS5 sensitivity scores. An Average Score Per Taxon (ASPT) was calculated for each site. The results showed a general trend of increasing sediment metal concentrations, land use practices and habitat alterations, with concomitant decreasing ASPT’s, from site 1 to site 5, indicating a loss of certain sensitive species at the most impacted downstream sites. Although metal pollution was found to be relatively low, a cocktail of pollutants, coupled with structural alterations, are clearly impacting the health and integrity of this river system. A future study should focus on organic pollutants, as agriculture is one of the main land use practices in the area.

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 Cinégeticos / Department of Life Sciences; P. Acevedo, IREC-Instituto de Investigación en Recursos Cinégeticos; A.I. Pàis-Costa, MARE-EBID; L.R. Vieira, ICNAS & CIMAR, University of Porto / Department of Life Sciences; L. Guilhermino, ICNAS & CIMAR University of Porto / Department of Biology; R. Ribeiro, Universidade de Coimbra / Life Sciences; J.C. Marques, IREC-Instituto de Investigación en Recursos Cinégeticos; A.J. Pais, EEBID-Instituto de Investigación en Recursos Cinégeticos; L. Guilhermino, ICBAS & CIMAR University of Porto / Department of Biology; A. Toschki, Research Institute gaiac / 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 like a screening test are used in 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.

TU118 Chronic testing of mayfly and stonefly species - Development of a new approach M. Brüggemann, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; K. Schlich, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; C. Schaefers, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology Aquatic organisms, especially lotic invertebrate species originating from running waters, are exposed to releases of plant protection products which are mainly used in agriculture. Since lotic invertebrate species are regarded to be very sensitive but are hardly considered in chronic ecotoxicity testing, we developed a test system in order to investigate chronic effects on mayfly and stonefly species. After determining the relationship between water quality and mayfly communities, using SASS5. Water and sedi-
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. Once the cultures of 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 each test substance, which different aquatic invertebrates, 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 exerting 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 12.68 μg L⁻¹, and the equivalent to 126.8 μg L⁻¹ CAR (or CAR dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were so as to have the same molarity as azinphos-methyl, an insecticide previously used in our laboratory. In bioassay 1, eight glass vessels per test 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), carboxylesterases (CeEs) with two substrates, glutathione S-transferase (GST), glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). In bioassay 2, containers per treatment were used with a single recently-laid egg mass each. The time and success of hatching were registered and, after one month, the survival of the offspring was evaluated. In both bioassays, CAR solutions were renewed every 48 h based on previous stability studies. The active compound caused an increase in the activity of SOD with both concentrations (28 and 83%, respectively, compared to the solvent control). The inhibition of CAT activity (50% and 60%, respectively, compared to the solvent control) was observed at both concentrations. Acetone is a solvent, at the concentrations used, it can potentially induce stress in test organisms. In bioassay 1, the results of the inhibition of CAT activity were reported to be more than double of the level found in control with CAR. Therefore, the results of the inhibition of CAT activity were compared to acetone controls. No significant differences were found in the inhibition of CAT activity in both bioassays. No significant differences were found in the inhibition of CAT activity in both bioassays. No significant differences were found in the inhibition of CAT activity in both bioassays. No significant differences were found in the inhibition of CAT activity in both bioassays.

TU120 Toxicity of lanthanides to freshwater microcrustaceans

M. V. Jahn, UBA-CONICET / Department of Inorganic & Physical Chemistry / Department of Materials and Environmental Technology; A. Lukjanova, H. Vija, A. Kahru, I. Cossi, CONICET / Department of Inorganic & Physical Chemistry / 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 accelerated by the synthesis and commercialization of different lanthanides, 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.

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 and 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. E(L)C₅₀ values of Gd and other Ln were 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 25% at the largest tested concentration (50 mg Ln/L). 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 Ln/L). It was revealed that mortality was a more sensitive endpoint than reproduction. Differences between E(L)C₅₀ values for Gd and other Ln were 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

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, able to detect toxic effects at 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 crinoids, 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 not, and even environmental matrices such as sediment elutriates. 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 alternative to 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 into 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

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In Louisiana, crayfish are not just a standard invertebrate species found in bayous and rice fields but also a staple in the cuisine and culture. Over 82 million pounds of crayfish are harvested annually, resulting in a $45 million industry; therefore, they are both ecologically and economically valuable in the region. In areas such as Louisiana where an invertebrate species is of such importance, incorporating that species into ecotoxicology testing may benefit the overall risk assessment for the chemical in question and any potential effects to the organism itself. For example, dicloran is the active ingredient in the fungicide Botran™, which is used throughout Louisiana to control crayfish. The toxic and phototoxic impacts of dicloran were analyzed using a vertebrate and invertebrate species (fathead minnows, Pimephales promelas, and red swamp crayfish, Procambarus clarkii). Fathead minnows showed negative impacts at concentrations as low as 0.1 mg/L and >90% mortality at 0.75 mg/L and red swamp crayfish showed negative impacts at concentrations ranging from 0.50-1.0 mg/L, the effects at similar concentrations show that P. clarkii is a useful, nontraditional organism to be used for ecotoxicological analyses in areas such as Louisiana where they are of such high importance. The use of crayfish, or other valued invertebrates, in ecotoxicology testing are additionally beneficial as they do not require IACUC approval and can likely be spawned in labs.

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.
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 route depicted here does not fit the 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 Ca" with other divalent metallic elements. ‘Latticine 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 routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

TU124 Development in vitro and in vivo methods of measuring acetylcholinesterase and general esterases in aquatic invertebrates

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Quantification of acetylcholinesterase (AChE) and general esterases activity involves 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 and C. riparius. The aim of this comparison was to compare the efficiency and selectivity 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 acetyltyrosine as substrate, measuring tyrosine 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-methylumbellifereone 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. To compare these results, we used with a 24-channel based respirometry system (SDR Sensor Dish Reader, PreSens, Germany). The system allows simultaneous measurement of 4 replicates and 4 controls. Survival and loco-motory 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 fluorine (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 transcriptional level of phase I (CYP1-like, CYP2-like, CYP2A11 and CYP156A1-like) and phase II (GST-like, GSTm-like and SUL-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) was lower than fluorine (100 mg L\(^{-1}\) = 5 h and 54 min). These results might be related to the higher lipophlicity of pyrene, facilitating its influx through the plasma membrane into the intracellular space and enzymes in pyrene biotransformation. This study contributes to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Moreover, a Physiological and biochemical response of the oyster exposed to the fluorine was evaluated. Transcription level of phase I were higher in 200 mg L\(^{-1}\) of pyrene (96 h). Transcription levels of all genes were higher in oysters exposed to 100 mg L\(^{-1}\) of pyrene (24 h). Besides, CYP2A11 (24 h and 96 h); GST-like (24 h and 96 h) and SUL-like (24 h) were higher in oysters exposed to pyrene 50 mg L\(^{-1}\). EROD and GSTm activities were higher in oysters exposed to 100 mg L\(^{-1}\) of pyrene (96 h). These results suggest an important role of phase I and II biotransformation genes and enzymes in pyrene biotransformation. This study contributes to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Moreover, this study suggests a participation of these genes and enzymes in pyrene biotransformation metabolism. In addition, it suggests the participation of CYP2A11 in the biotransformation process of PAHs in gills of *C. brasiliana*.

**TU128 BIOCHEMICAL AND CELLULAR RESPONSES OF THE CRAB PACHYGRAPUS MARMORATUS TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOUR (ITALY) AND OF AN ADJACENT MPA**

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The main purpose of the present investigation was to assess the toxicological status of Livorno harbour in Italy and of an adjacent MPA, through the responses of a set of biomarkers in the crab *Pachygrapsus marmoratus*. This investigation is part of the IMPACT project (Port on Marine Protected Area: cross-border co-operative actions), which has the purpose to develop cross-border management plans to actually protect the Marine Protected Areas. Male and female crabs were collected from the different areas: Livorno harbour, considered a polluted area, and the un-polluted protected area and adjacent gulf of Pisa, managed by the MPA. This study focused on the Livorno harbour, where we intended to explore the eventual adverse effects of port contamination. A battery of biomarkers was employed to assess neurotoxic effects (acetylcholinesterase, AChE activity), energy metabolism (isocitrate dehydrogenase, IDH; lactate dehydrogenase, LDH), oxidative stress (lipid peroxidation, LPO; glutathione S-transferase, GST; glutathione peroxidase, GPX; glutathione reductase; GR; catalase, CAT; glutathione, GSH) and DNA damage (erythrocytic nuclear abnormalities,ENA assay) in the crabs. The levels of trace elements and PAHs were also evaluated in the sampled specimens. Results showed that the crabs sampled at Livorno harbour are exposed to contaminants able to cause oxidative stress and genotoxic effects. LPO and ENA assay showed a statistically significant difference between specimens collected at Livorno harbour and the samples coming from the MPA. The average values of LPO were about three times higher in crabs sampled in Livorno harbour in comparison with that sampled in the MPA. The results trends are not influenced by the sex and the female showed higher values of biomarkers in comparison with the males. The crab *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.

**TU129 Toxicty of titanium on the mussel Mytilus galloprovincialis**

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Titanium (Ti) is at forefront of research related to nanomaterials. Due to their physical and chemical properties, Nanoparticles (nTiO\(_2\)) are widely used in aquatic environments and industries, such as additives in pharmaceuticals and food colorants, toothpastes, solar cells, sunscreens, cosmetics and boat paints. With the increasing production and use of nTiO\(_2\), Ti has been inevitably released into aquatic systems through wastewater treatment plants, surface run-off, direct inputs and atmospheric deposition. The increasing input of nTiO\(_2\) in the aquatic environment has raised concerns about the toxicity of Ti to inhabiting organisms. Once in the aquatic environment nTiO\(_2\) interact with the surrounding water components, including other contaminants, which may change the availability of Ti to organisms, namely the ability to penetrate into cells which may result in toxicity. In the present study the mussel species *Mytilus galloprovincialis* was used to evaluate the impacts caused by the exposure of Ti (II) solutions with the initial concentrations of 5μg/L, 50μg/L, 100 μg/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 mussel, varying with the concentration and time of exposure. Mussels exposed to Ti presented lower metabolism, represented by lower cell transport system (ETS) activity, which decreased along exposure time decreased their metabolic rate, showed their glycogen (GLY) and protein (PROT) contents. Moreover, contaminated individuals activated their antioxidant defences increasing the activity of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) 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).

**TU130 Comparing interspecific Artemia responses to chronic zinc exposure**

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The invasive species *Artemia franciscana* is displacing native *Artemia (A. salina* and *A. parthenogenetica)* from eastern Atlantic coasts and across the Mediterranean region. Due to its high mobility, strong swimming ability and high reproductive rate, *A. franciscana* is currently expanding far away from few remaining sites with native *Artemia*. Most studies indicate that pollution generally favours invasion of exotic species. However, recent studies suggest that local adaptation to the contaminated conditions by the native population may prevent colonization by *A. franciscana*. Under this context, the sublethal toxicity of zinc was assessed in natural populations of *A. parthenogenetica* from the highly contaminated Odil estuary (Odiel River, southern Spain) and *A. franciscana* from the highly clean (Cadiz bay, Spain, SW Spain). The Zn concentration used in our experiments (0.2 mg/L) was the double of that recorded in water from the Odil estuaries to make our results as relevant as possible to real field conditions. Cysts were hatched in seawater and nauplii (*A. parthenogenetica*) or separated in couples (*A. franciscana*) according to their gender, control and treatment and a set of reproductive parameters were examined. Results showed that *A. franciscana* performs better (higher survival and growth) than *A. parthenogenetica*. Both species experienced significant slower growth and higher mortality when exposed to Zn, but not significant effects were found in final size. Regrading reproductive parameters, Zn exposure increased offspring production of both *Artemia* species when compared to control. However, native *A. parthenogenetica* exhibited a better performance (higher number of broods and offspring production; lower % non-viable nauplii) than *A. franciscana*. The results of this work highlight competitive advantages of native species (*A. parthenogenetica*) from contaminated areas to prevail under the selective pressure of abiotic factors as environmental pollution. Based on these results the highly polluted Odil estuary would not be a refuge for native *Artemia*, gene flow towards *A. franciscana* suggested by the theory of local adaptation. **Keywords: Artemia species; Local adaptation; Sublethal exposure; Zinc contamination.**
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. Moraña, G. 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 instrument 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 echinoderm Paracentrotus lividus, as a different endpoint. In detail, 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 novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory 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
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Since target chemical analysis often cannot explain the cause-effect relationship between certain contaminants and the observed effects in organisms, effect directed analysis (EDA) can be applied to unravel the drivers of toxicity in complex mixtures. In this study, the sea-urchin embryo test (SET) was implemented for the first time in a EDA approach in order to evaluate an estuarine environment influenced by the effluent of the main waste treatment plant (WWTP) of Bilbao. WWTP sample (225 L) was extracted in a sequential LC-UV fractionation methodology based on two different columns: a Nucleosil C8 column (21 fractions were collected) and an aminopropyl column (15 fractions). Two endpoints were used to detect 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 =39 μL) for only 6 hours. Thanks to a modern video-based technology, this study provides novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU134
Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity
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Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxide 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 or drugs such as ibuprofen and aspirin. However, 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, pgd2a 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 transcriptome. To evidence transcriptome analysis, 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 Pb were changed to a clean media for recovery for three generations. To monitor acclimation, starting with acute immobilization tests to evaluate the effect of chemicals on eicosanoid pathway synthesis. Also, 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
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Plankton human activities are constantly 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 evidence transcriptome alteration, we carried out 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 Pb were changed to a clean media for recovery for three generations. To monitor acclimation, starting with acute immobilization tests to evaluate the effect of chemicals on 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, pgd2a 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 transcriptome. To evidence transcriptome analysis, 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 Pb were changed to a clean media for recovery for three generations. To monitor acclimation, starting with acute immobilization tests to evaluate the effect of chemicals on eicosanoid pathway synthesis. Also, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

TU136
Chronic effects of BPA, BPS, and BPSip in Daphnia magna
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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 when exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<p 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-2015R1D1A101056628).

TU137 Oxidative effects of mono-(2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level
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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 2008/105/EC on phthalates of MEHP acts as aocrine 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 antioxidan 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?
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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. In EU regulation 2008/105/EC on phthalates of MEHP acts as aocrine disrupting chemical in aquatic organism such as Daphnia Magna. In recent years even the use of first instar larvae of Chironomus riparius (Insecta, Diptera) has been proposed (OECD test guideline n. 235, 2011) to be used to complement existing Test Guidelines for chromidom chronic toxicity assays (OECD test guidelines 218, 219, 2004) (OECD Test Guideline n. 233, 2010). Chironomus riparius is generally used to test the quality of groundwater, because it is the first daphnids in the water column before becoming benthic for the other three larval stages. As a matter of fact, the Chironomus acute test can be a useful tool to control the quality of sediments but during its first days of life it freely swims in the water. The aim of this study is to compare the responses of Daphnia magna and Chironomus riparius when exposed to the same contaminant, we carried out different exposures using three different substances: two reference items (potassium chloride, and potassium dichromate, used to mimic the toxicative mixtures resulting from PCP and interaction with plastic of PCP containers. These mixtures were used to reach the biota of freshwater ecosystem so the main objective was studying of the effects that the mixtures can have on an invertebrate with a relevant 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. Expression profile of 42 genes was analysed by retrotranscription and Real-Time PCR using a specific array covering a relevant number of 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), CMT2015-64913-R/a.A.B.M.G is the receiver of a pre-doctoral contract from the National University of Distance Education (UNED).

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius
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Natural populations are constantly facing a 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 and contributes to the 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, which allow for genetic sensitivity to be measured and estimation of 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 emergence and imagoes weight were used as endpoints. 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
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Amitraz is a very effective formamidine insecticide used in agriculture to control fleas, ticks and cotton pests. Due to its widespread use and high direct application rates, there is an elevated risk of contamination of adjacent aquatic ecosystems. However, the information of amitraz toxicity to aquatic non-target invertebrates is scarce. In this study, the toxicity of amitraz to the midge Chironomus riparius (Meigen) was assessed in terms of life history responses using standard ecotoxicological tests and biochemical endpoints using oxidative damage, antioxidant defenses, energy metabolism, and neuromuscular toxicity biomarkers. Chronic exposure to amitraz contaminated waters (28 days; 10, 20, 40, 80, and 160 µg L−1) resulted in impairment of C. riparius emergence and developmental rates (reduced larval growth and delayed emergence), with male development time being
Coelomocytes compose a heterogeneous cellular group where two major cell types, amoebocytes and eleocytes, are distinguished. Amitraz, a synthetic pyrethroid, is a common insecticide used in agriculture. It is known for its potent and broad-spectrum activity against a wide range of arthropod pests. In recent years, the use of such chemicals has increased due to their effectiveness against various pests. However, it has been observed that the subpopulations of coelomocytes respond differently to stressors, indicating the existence of distinct subpopulations with varying responses to environmental conditions.

Earthworms play a crucial role in soil biogeochemistry, acting as key ecosystem engineers. They contribute to soil fertility, nutrient cycling, and decomposition processes. The immune system of earthworms, known as coelomocytes, is highly versatile and can respond to a wide range of environmental stressors. The effects of pesticides and other pollutants on earthworms, particularly on their coelomocytes, have been extensively studied.

The study on earthworm immune cells (coelomocytes) has become a target system in Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology. The 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-MAA/1302/2012), co-financed by COMPETE (POCI-01-0145-FEDER-016773).

TU142 Multigenerational exposure of Folsomia candida to copper agrochemicals: conventional and nano-pesticides

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TU143 Effects of multiple environmental stressors on Eisenia fetida coelomocytes: cell viability and different behaviour of amoebocytes and eleocytes

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Earthworms are an indicator organism 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, 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 Eisenia 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 several metal conditions (Cd: 5-25 mg/kg dw., Ag NPs: 0-100 mg/kg dw) 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 amoeboe/eleocytes. Coelomocytes extruded from earthworms maintained under low OM content, in high-temperature showed 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 species to assess accurate soil health assessment in a global warming scenario. Acknowledgements: Basques Gov (IT810-13). Univ. Basque Country (UFI 11/37) and MINECO (Nanosilveromics Proj).

TU144 Terrestrial arthropods as indicators of environmental pollution

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In recent years, the use of and interest in terrestrial arthropods as indicators of environmental pollution has increased. Arthropods are diverse, with over 31,000 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 significant as indicators of pollution in the immediate area. In most studies, the sampling sites were close to old mines, or the studies were comparisons of arthropods from different locations. Published literature on terrestrial arthropods not only focuses on whole body utilization 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 need for more ecological relevant evaluations of environmental risk associated with chronic exposure to soil agrochemicals.
lack of sufficient data on most terrestrial arthropods as indicators. We discuss a number of possible predatory taxa, such as dragonflies, spiders, wasps, and beetles.

TU146
The impact of chlorpyrifos and its formulations on the acetylcholinesterase activity in non-target soil organisms
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 the 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 against predatory mites on apple (Cydia pomonella and Lobesia botrana respectively), 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 (Albiz, ATR 80 yellow), low-drift nozzles (Albiz, TV1 80015 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
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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 the present study, we observed the behavior 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, MP20; 20 mg F, F20; 10 mg MP + 10 mg F, MP10F10). The behaviour patterns were recorded and quantified. Diving beetle fed the adult zebrasfish, 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 zebrafish wet/seg. The exposure group, which fed the MP10F10 exposed zebrasfish, showed the significant decreasing (p < 0.05) of ingestion rate (0.55±0.08 zebrafish wet/sec) during 591±85 seconds. On diving beetle, the MP were only found at crop organ until 720 min after ingestion, and did not transfer to another organism. 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 Science 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
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Microplastic pollution of marine environment is an environmental issue which is intensely 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 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, MP20; 20 mg F, F20; 10 mg MP + 10 mg F, MP10F10). The behaviour patterns were recorded and quantified. Diving beetle fed the adult zebrasfish, 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 zebrafish wet/seg. The exposure group, which fed the MP10F10 exposed zebrasfish, showed the significant decreasing (p < 0.05) of ingestion rate (0.55±0.08 zebrafish wet/sec) during 591±85 seconds. On diving beetle, the MP were only found at crop organ until 720 min after ingestion, and did not transfer to another organism. 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 Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).
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 washing. The fiber size and shape, the washing and decomposition 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.


The past ten years has seen increasing scientific and public concern over the occurrence of microplastics in the environment. Most studies in both aquatic and sediment compartments. We found that many of the reported impacts on molecular level endpoints, feeding, fish eggs, reproduction, lea

In addition to the detection of 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 radioabeled 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-radio labelled 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-labelled CaPSS to prove success. The 14C-radio labelled polymer is detectable in sludge matrix as well as the mineralization 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 14C-microplastic in environmental matrices is currently orders of magnitude below the lowest level of detection in aquatic systems, this study 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 endpoints associated with MPs in aquatic systems, including avoidance, 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 disprove 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
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Wastewater is one of the exposure pathways of microplastic into the environment. Wastewater systems have a key role for the transport of microplastics 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 washing. The fiber size and shape, the washing and decomposition process. We performed at realistic/environmentally relevant concentrations. As the detection limit of 14C-microplastics in environmental matrices is currently orders of magnitude below the lowest level of detection in aquatic systems, this study can serve as an example how future studies on the general topic ‘microplastics in the environment’ can be supported.

TU154 Applicability of remote sensing methods for indirect mapping of microplastic distribution within aquatic ecosystems
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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-mobile plankton or other organic material, we tested the hypothesis that a combination of a functional textilie containing other microplastic and specific water parameters. In situ water parameters, microplastic (5nm – 250μm), 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 peroxide 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 with 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.
TU155 Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ sample collections and ocean current moulding

E.C. Atwood, RSS Remote Sensing Solutions GmbH; F.M. Falcieri, CNR - ISTM; C. Verster, North-West University; S. Piatti, University of Bari; S. Piehl, University of Bayreuth; E.C. Atwood, RSS Remote Sensing Solutions GmbH

Phytoplankton in inland waters and the open ocean is a long recognized problem for marine life, 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 sampling at a beach (sampled particle size range: 1-5 mm). Hydrodynamic modelling suggests that the amount of discharged plastics 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.

TU156 Cause and effect of the plastic industry in South Africa as a developing country

C. Verster, North-West University - School of Biological Sciences / Environmental Science 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 domestic water, sewage treatment water and river systems. 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, sludge treatment, and runoff 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 scanning electron microscopy (SEM) or FT-IR microscopy. MPs by FT-IR microscopy 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-particle samples 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; P. Medlin, Aalborg University / Civil Engineering Department Microplastic (MP) pollution is nowadays recognized as a global concern affecting both marine, freshwater and also the terrestrial environment. Beside microplastic pollution, also micro-particle paints (MPP), originated by the degradation and abrasion of painted surfaces (buildings, ship-paint materials) have been reported in some recent studies. As many paints also contain organic compounds and heavy metals used as biocides aimed to inhibit the growth of biota on painted surfaces, these particles could be even more harmful to the environment and wildlife than microplastics. Here we present some results obtained from the analysis of soil samples collected in a recreational boat facility in the North of Denmark. A “Microplastic-based” approach has been used, extracting the particles from the soil matrix using air-assisted density separation followed by FPA-µFTIR-Imaging analysis. This approach allows to identify and quantify microplastics and micro-particle paints down to 10-20 µm in size. Surficial soil samples were collected along three transects located in different areas of the shipyard. The samples, previously sieved (500-500 µm and 500-100 µm) were submitted to flotation using ZnCl2 followed by sample cleanup using enzymes and H2O2 oxidation to remove organic matter. The analysis was carried out using FPA-µFTIR-Imaging spectroscopy and the data were processed with a dedicated software (MPHunter) developed at Aalborg University. The first results highlighted a high micro-paint and microplastic particles contamination. The total MP and MPP concentration were 222,500 particles kg-1, while the estimated mass was 17.1 mg kg-1. The most abundant polymers/paints detected were polyester (30%), acrylic coating (20%) and polyethylene (7%). The particle size distribution showed the most abundant size ranges were between 20 - 40 µm and 40 - 80 µm. The high MP and MPP concentration measured in the sample highlights the harbor areas are potential hotspots for the accumulation and further spreading of MP and MPP in the terrestrial and aquatic environment. Microplastic and micro-paint particles were successfully extracted and detected in a recreational harbor using the art analytical approach including multiple-step sample preparation and FPA-µFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

TU161 Runoff of microplastics from agricultural soil: a study in a semi-arid area
R. Herlin, NIVA - Norwegian Institute for Water Research; T.C. Schell, IMDEA Water Institute / Ecostoxology; R. Høyland, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecostoxology; 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 much of this is incorporated into the sludge phase. Therefore, the use of sludge as a fertiliser for agricultural soils may be a relevant source of MPs in the terrestrial ecosystem and, through runoff, in surface waters. The fate of MP applied with sludge is strongly dependent on weather conditions (rain, temperature, etc.). The objective of this study was to determine the fate and distribution of MPs in the agricultural soil-water system. The study was performed in an experimental farm of IMIDRA (International Research Institute of Stavanger, Desarrollo Rural, Agrario y Alimentario) located in central Spain, in an area characterised by 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 determine potential accumulation and MP impacts on the soil fauna. The content of MPs in runoff water, soil and biological samples was 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 FTIR. 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 / Ecostoxology; R. Høyland, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecostoxology; 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/size sorting is not well understood. During two different seasons (summer and autumn) at three differently impacted sites: i) low human impact; ii) high agricultural impact; and iii) high mixed impact (urban, agricultural, industrial). MPs in river water and wastewater were divided into four fractions by filtering a suitable amount of water through plankton nets of different mesh sizes (from 300 to 20 µm). In order to assess the MP concentration and composition in the samples, solid substrates (sludge and river sediment) were subjected to an organic matter removal treatment, followed by density extraction. Subsequently, those samples, as well as the liquid samples (river and wastewater), were filtered onto filter papers to visually identify the MP content and then chemically characterize their polymer composition using Fourier transform infrared spectroscopy. Finally, the more abundant characteristics of the rivershed (total population, characteristics and location of WWTPs, agricultural land use patterns including sludge application, etc.) will be integrated into the study’s findings to deduce their importance for MP contamination. The preliminary results of the distribution and characterization of MP in different matrices are presented.

TU163 Microplastics occurrence and composition in drinking water from a Norwegian urban area
a. gromeyer, International Research Institute of Stavanger / Environment; G. Skogerbø, IVAR; K. Øysæd, A. Vatland 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 fragments of different polymers and different particle sizes in the sludge phase. The most suitable spectroscopic technique for an unbiased MP detection and quantification. The risk of plastic uptake from drinking water is currently unpredictable and furthermore, these plastic particles are in addition to plastics potentially consumed in the drinking water and their implications on human health. According to the WHO men should consume 3 L and women should consume 2.2 L of beverage per day. Most of these beverages consist of tap water, or drinks derived from tap water (such as coffee, tea, or reconstituted juice). The risk of plastic uptake from drinking water is currently unpredictable and furthermore, these plastic particles are in addition to plastics potentially consumed in the drinking water and their implications on human health. According to the WHO men should consume 3 L and women should consume 2.2 L of beverage per day. Most of these beverages consist of tap water, or drinks derived from tap water (such as coffee, tea, or reconstituted juice).
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 GC/MS-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

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It is now known that the vast majority of microplastics found in the seas and oceans originate from lands. In such a process fresh water 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 (U.V., rain, wind, mechanical erosion, ...) which will continue and amplify its degradation, leading to its fragmentation. Our work we have undertaken consists of: 1) Mapping the presence of the microplastics and the toxicity and chemical composition over time of macroplastics 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 Plasticscages project supported by the CNRS[1, 2, 4]. Collect and analyze the composition of microplastics in the surface waters of different french rivers (Allier, Charente, Loire, Touvre, etc.). To do this, we rely on citizen science operations, in particular thanks to the contribution of the babybeads sampling net [3,4], which makes it possible to multiply samples and analyzes. 1 Occurrence of plastic litter in the Allier river in France. Vincent Verney, Gaëlle Bissagou Koumba, Alexandre Garreau, Florence Delor-Jestin, Erwan Rousséau, Olivier Voldoire, Jean-Luc Peiry; To be published 2- https://www.researchgate.net/project/PLASTICSCAGES 3- Promiss agency, the case of babybeads, Max Liboiron, Engaging Science, Technology and Society (3), 2017, 499-527 4- http://lapagiaiesauvage.org/laboratoirerecyleyhn

**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 quantification is still lacking in terms of their presence in the freshwater environment. 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 catchment area, both upstream and downstream of 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 coloured fragments, films, beads, and fibers were identified, with the majority of microplastic contamination being in the form of fragments. Both the total concentrations and the proportion of each type of plastic varied with distance downstream and size class, suggesting changing inputs as the river flows through the city. No differences in either concentration or composition were found between sites upstream and downstream of the WWTP, suggesting a lack of significant input to the river. Moving forward, the chemical composition of suspected microplastics will be investigated using Raman microspectroscopy. This work represents one of the first studies on the occurrence of microplastics in the freshwater environment in Western Canada and will provide a baseline for future monitoring studies.

**TU166**
A Historical Sediment Record of Microplastics in an Urban Lake, London, UK

S. Turner, University College London / Geography; A.A. Horton, Centre for Ecology and Hydrology; N. Rose, University College London / Department of Geography

A historical record of microplastics extracted from a radionuclide (210Pb and 137Cs) dated sediment core from a London lake provides novel data on the long-term deposition of microplastic waste in freshwater systems. Microplastic particle abundance and calculated accumulation rates are indicative of plastic usage in the 20th century. Concentrations of microplastics extracted from the sediment, by sieving and floatation using dense liquid separation range from 30 to 880 particles per kg of dried sediment. Fibres dominate the assemblage of microplastic particles identified in the time-resolved sediment samples. Poly styrene microplastic particles were identified and are found in post-1950s sediment and up to the present day. An increase in microplastic concentration is evident in recent sediments (post 2000) but a peak in concentration is also observed in late 1960s-1970s age sediment. Raman spectroscopy of selected particles and fibres provides compositional data on the fibres and particles found in the sediment. The size and nature of microplastic particles found in the sediment sequences will greatly assist in quantifying the historical flux of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.

**TU167**
Microplastics from sewage treatment works and storm water outfalls discharging into the Victoria Harbour, Hong Kong SAR

C. Mak, Y. Tsang, The Chinese University of Hong Kong / School of Life Science, Environmental Science; K. Chan, The Chinese University of Hong Kong / Life Sciences

We conducted surveys of microplastic pollution in the surface waters and sediments from Deep Bay, Tolo Harbour, Tsing Yi, and Victoria Harbour in HK SAR. In the microplastics survey (June 2015 to March 2017), the averaged concentrations of microplastics in local coastal waters and sediments respectively ranged from 51 to 270 (0.02-0.01 x 10^6 particles per m^3) and 49.0 ± 2.6 x 10^3 particles per kg soil. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per 100m^3 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) (Kwan Tong Ferry Pier, New Yau Chau + Ma Tei Typhoon Shelter, which are potential microplastic pollution sources entering into the Victoria Harbour. Effluent samples from each of the two sources were collected in three weekdays per month and different seasons (December, March, June and September) to determine spatial, temporal (seasonal) and vertical 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 100m^3 (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 endocrine biomarker vitellogenin 1(VTG1) studies. Our objectives in microbeads exposure 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).

**TU168**
Models for Data Synthesis, Sampling Design and Scenario Analysis: Some experiments using the INCA-MP model of microplastic fate and transport in soils and surface waters

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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 achieve. Here, we show how the INCA-MP, the Integrated Catchments model for Micro Plastics, the first published model of microplastic terrestrial fate, riverine transport and contaminant co-transport can be used to synthesize available data, identify knowledge gaps, plan monitoring, and perform risk assessments. Synthesizing available data involves collation of microplastic and proxy data. We show how proxy information, including timing and chemical composition of microplastics, can be used for more intensive field sampling campaigns. As 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 plastic 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. Campanale, 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 objects <50 µm in the weathered particles and sediments. In total, 552 to 1343 µm showing significantly higher abundances during February and April campaign (Mann–Whitney U Test = 18.09; p-value = 0.028). A total of five foam 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 (0.9%) 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. Borresen, Aalborg University / Department of Civil Engineering; F. Liu, J. Vollandt, Aalborg University / Civil Engineering Department In this study the efficiency of a disc filter for removing microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10-500 µm and the identification technology was micro-FTIR imaging spectroscopy applying a focal plane array (FPA). Effluent wastewater was collected at the wastewater treatment facility at Grindsted, Denmark operated by Billund Sludgevarde A/S. The treated wastewater was sampled before and after the disc filter by using 100 µm-stainless steel mesh. The collected large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m² 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 precipitation, and liquid chromatography–mass spectrometry (Pyrolysis GC-MS). The composition of microplastic was studied in terms of size, shape, color and polymer type. Results from the six replicates are expressed as mean values (± DEV. ST.) of number of particles per cubic meter (p/m³). Microplastics were found in each net sample for a total amount of 22152 items collected, photographed and categorized. Sample concentrations ranged from 3.52 to 13.43 p/m³ showing significantly higher abundances during February and April campaign (Mann–Whitney U Test = 18.09; p-value = 0.028). A total of five foam 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 (0.9%) and PU (0.4%).

TU171 PlasticBudget - Project on the environmental assessment of microplastic emissions

N. Thonemann, 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 probably affects the food chain. The long distance and long residence times of plastic waste will, in any case, 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. Gorokhova, 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 microplastics, test organisms and conditions. While 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 microplastics to be distinguished from those caused by background particles. This separation is crucial for testing MP-specific effects, as many test organism 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 clearly 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 micropollutants like pharmaceuticals, can be charged under certain pH conditions. While it is known for a wide variety of natural particles that charged compounds sorb only little or not at all, sorption interactions between microplastics and charged compounds have not been analysed so far. Thus, the aim of this study was to clarify the sorption behaviour of dissociating compounds to microplastic particles. We measured the equilibrium partitioning between 19 typical wastewater contaminants (pharmaceuticals, personal care products, pesticides) and microplastics at three different pH values (4.7, 7.1, 8.0). The investigated compounds showed a wide variety in their physico-chemical properties, e.g. a log Kow range between 0.1 and 5.8 and pK_a-values from 1.6 to 13.9. We performed batch experiments with fourteen ionizable and five non-ionizable substances. In all experiments equilibrium was reached after two days. Measured log Kow for the neutral species ranged from 0.75 to 4.00. The uptake of contaminants varied according to their hydrophobicity. Sorption of ionizable substances is strongly influenced by the pH while non-ionizable substances showed a partitioning independent of pH. For sorption into polystyrene, the amount of accumulated pollutants is principally dominated by the neutral fraction, while the charged
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 poly styrene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil T. Huffer, S. Sławeń, 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 low durability and limited recovery [2]. Polyethylene is one of the mass-manufactured polymers that is found in the terrestrial environment, used in many different sectors, including agricultural mulches, composts and package 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 insolation, 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 prototaxy, because they can interact [5]. The objective of this study was 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. Riligrig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornin, M. Bijarini, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson, Mar. Pollut. Bull. 2012, 64, 782. [5] T. Huffer, T. Hofmann, Environ. Pollut. 2016, 214, 194.

TU175 Influence of poly styrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornuarietis: behavioral and biochemical responses S. Kraiss, University of Tübingen / Animal Physiological Ecology; H. Schmieg, Tübingen University / Animal Physiological Ecology; E.E. May, University of Tübingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tübingen / Animal Physiological Ecology; R. Triebkorn, University of Tübingen / Animal Physiological Ecology. Despite the large production and usage of plastic products in the last decades, the quantity of globally produced synthetic polymers rises continuously increasing in high amounts of plastic debris of all sizes in the environment. 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 of particular interest in ecotoxicology, because they can interact with organisms 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 poly styrene 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 poly styrene particles per liter (cryogenically milled, < 100 µm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiachloprid. In order to quantify the observed behavioral responses, five categories of behavior were defined, which are: “crawling”, “attached to the wall”, “attached above the water surface”, “inactive on the ground” and “retracted with closed operculum”. All snails were individually categorized twice a day for nine days. The results make evident that snails exposed to cypermethrin significantly changed their behavior between the first (day 1-4) and second (day 5-9) observation period, independent of the test concentration. In the first period, they were often categorized as “attached to the wall” or “attached above the water surface”, whereas in the second observation period, these snails were mainly classified as “inactive” or “retracted”. As biochemical endpoints we study oxidative stress (lipid hydroperoxides, superoxide dismutase), proteotoxicity (Hsp70 level) and neurotoxicity (inhibition of acetylcholinesterase). The analyses, however, are still in progress. The study is part of the joint research project MWa (“microplastics in the water cycle”) funded by the German Federal Ministry of Education and Research (support code: 03W0923B).

TU176 Effects of artificial weathering on polypropylene microplastics V. Fernández-González, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); G. Gruiero-Noche, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); J.M. Andrade-Garda, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. López-Mahía, Universidade da 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 in the thousands of years, but 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 BASEMAN 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 polypropylene microplastics using ATR-FITR. 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 absorption peaks can be seen, that reveal 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 on weathered microplastics. Effects are typically dose-dependent. SEM images revealed that the microplastics experienced mechanical erosion and weathering. These results reveal that an adequate pretreatment of the sample along with an adequate customized polymer library that contains real/weathered polymers spectra are highly recommended for the adequate monitoring of microplastics in the environment. Acknowledgments: Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) partially financed by ERDF (ED431C 2017/28). Ministry of Economy and Competitiveness: PCIN-2015-170-C02-01 BASEMAN-JPI Oceans and, project CTM2016-77945-C3-3-R (ARPA-ACUA).

TU177 Freshwater microplastics and effect of conditioning on pollutant and chemical transfer potential K. Reilly, The University of Birmingham; J. Sadler, The University of Birmingham / Department of Geography and Environmental Science; I. Lynch, University of Birmingham / Geography Earth Environmental Science

The presence of microplastics in the environment has received increasing scientific and societal interest over recent years. Following this, there has been a range of scientific studies and discussions on impacts that microplastics are having in the environment and how we can mitigate this, leading to changes in legislation, although more is needed. Micro, and recently nano, plastics have been shown to have a range of detrimental effects on various organisms in both field and laboratory studies. Effects are typically dose-dependent. SEM images revealed that reduced feeding and successful reproduction, change in organism’s behaviour and decreased survival. This study aims to build on current research on the effects of freshwater microplastics, focussing on the micro and nano plastics potential to transfer chemicals in the environment. The formation of a corona on plastic particles changes their surface characteristics which could lead to a change in how bioaccumulation of chemicals interacts. In this study we explored the effects that plastic conditioned under different scenarios can have on the interaction with Daphnia magna (a keystone species). We assessed this using several parameters including: (1) quantifying the proteins and polysaccharides secreted by the organism’s before and after exposure, (2) quantifying uptake of plastic in the individual organisms, and (3) observing changes in behaviour (reproduction and movement). We explored these effects for pristine plastics and plastics combined with chemicals commonly found in the environment, including: 17α ethynylestradiol and detergents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess the effect how microplastics interact with other complex pollution issue in the environment. This study could help to explore the use of combined stressors using parameters that can be controlled in the laboratory. Through this, we can assess the impact of assumptions about test conditions, and the impact of over-simplification of standardised test media, on the resulting data regarding the Trojan-horse potential of micro and nano plastics. Building on this data we will be including recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

TU178 Exposure to conventional but non-biodegradable microplastics impacts fitness in Daphnia magna Z. Gerdès, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); M. Puranen, Stockholm University; M. Ogonowski, E. Gorokhova, Stockholm University / Department of Environmental Science and
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 conventional polymer. Therefore, 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 microplastics in freshwater ecosystems. 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 ecotoxicological activity at the polymer type level using different materials. 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. Rezbauch, 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. Trübyskorn, 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 specific 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 (cryogenically milled granules, fractionated to < 50 µm, up to 100,000 particles/L), also in combination with the pesticide methiocarb in juvenile (11 months old) brown trout (Salmo trutta f. fario). For that purpose, we conducted a fish early life stage 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 ecotoxicological activity at the polymer type level using different materials. To evaluate toxicity of these materials, it is essential to include a reference treatment as a benchmark.

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. Brun, CML Leiden University / Conservation Biology; J. Baas, Centre for Ecology & Hydrology / Centre for Ecology and Hydrology; B. van Loo, CML Leiden University / CML; C. Weil, CML Leiden University / CML; E. Tukker, CML Leiden University / CML; S. Magni, University of Milan / Department of Biosciences; F. Rezbauch, 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. Trübyskorn, 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 specific 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 (cryogenically milled granules, fractionated to < 50 µm, up to 100,000 particles/L), also in combination with the pesticide methiocarb in juvenile (11 months old) 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 indicator dihydroethidium (H2E) associated to the fluorescent dye Sytox Green (Molecular Probes). For that purpose, we exposed 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 and the induction of the 70 Kd stress protein (Hsp70) and the inhibition of acetycholinesterase 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 larva 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: 02WR1S378).

TU181 Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels
S. Magni, University of Milan / Department of Biosciences; F. Gagné, 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 Milan / Department of Environmental Science and Policy. The annual global plastic production follows a positive trend and plastic pollution represents an emerging worldwide issue. In particular, microplastics (MPs), plastic fragment smaller than 5 mm, are potentially dangerous for aquatic community because their ability to be accumulating in the tissues of biota. MPs can reach the aquatic environment through the Wastewater Treatment Plants (WWTPs) or affects the degradation of macroplastics. Considering that few studies, especially in freshwater environment, have been conducted about the adverse effects of MPs, the aim of our study is the evaluation of chronic toxicity of these contaminants on the freshwater mussel Dresiesena polymorpha using a multi-biomarker approach. As MP standards we choose two different beads of polystyrene, one of the most common MP classes detected in the environment, with a size of 1 and 10 µm. On the basis of the daily great release of MPs from WWTPs, we tested the following mixtures (MXDs) of polystyrene MPs: MIX1, which contained 2 million/L of 10 µm MPs and 2 million/L of 1 µm MPs, and MIX2, which contained 500,000/L of 10 µm MPs and 500,000/L of 1 µm MPs. Therefore, mussels were exposed for 7 days in static conditions to the MXDs and to related controls; every 3 days we collected from each tank the mussels to assess both chronic toxicity and uptake of polystyrene MPs. We evaluated the adverse effects by monitoring end-points of cellular stress, as the activity of antioxidant and detoxifying enzymes, oxidative damage, cyste-genotoxicity and neurotoxicity (analyses in progress). To evaluate the uptake of polystyrene MPs in the exposed mussels, exploiting the reflection of MPs, we collected hemolymph and then fixed them in a soft tissue for cryoant sectioning. We then observed the samples using the confocal microscopy. Despite we found both sizes of polystyrene MPs in the hemolymph and soft tissues of mussels, we did not obtain significant increase of tested biomarkers compared to control, excepted for a significant increase of CAT activity at the end of exposure for mussels exposed to MIX 2. The lack of adverse effects induced by tested MPs could suggests that the toxicity of MPs could be related to particle size. The exposure 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 18o, followed by D. pulex and D. magna, which were of comparable sensitivity, however, the trend was reversed at 26o C. In addition, SM5 was the most toxic to C. dubia. While 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.
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 polystyrene 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 response to MP 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. Wagner, 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 kinds of challenges, some of which had already been faced in researchers in the realm of nanotoxicology. Our ultimate objective 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 – also for many other groups. 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 fractocene-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 nanoparticles. 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 microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and nanomaterials studies is important, especially if these have a high impact on the body and need to be replicated in the realm of nanotoxicology. Our work elucidates about inhibited by a lack of transparency in reporting methodology and results. We were able to adapt a fractocene-based clearing protocol to the use with high amounts of *Daphnia* samples.

**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. Židar, 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 effects 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 ± 0.55 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/kg dry weight (0.4% w/w). The isopods were exposed individually in and 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, but 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**

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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, we assessed the potential of a mixture of microplastics (MP) and the pesticide chlorpyrifos (CPF) on aquatic organisms. We performed in a subchronic experiment of 14 days with two exposure concentrations (L and H) and one control group (C). After 14 days we performed a chemical analysis of CPF in the water phase of the bioassay and a stressor experiment in which we expose *Daphnia magna* and *Crangonyx pseudogracilis* to CPF at the day 14. CPF was applied in 4 mg/L. The same experiment was performed with the aim to discover the Trojan horse effect. This discrepancy may be based on differences between the studies. We were unable to detect 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 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, CPF must have become bioavailable to at least two different species, according to the lowered abundance levels in L and H compared to MPC. Thus, the reason why the presence of MP (without CPF) might have led to enhanced abundance still needs to be clarified.

**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. Jouassard, IFREMER; L. Sigier, Eawag; M. Bégout, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; J. Cachot, Université de 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 still 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 were lowered when CPF was present. In this, CPF must have become bioavailable to at least two different species, according to the lowered abundance levels in L and H compared to MPC. Thus, the reason why the presence of MP (without CPF) might have led to enhanced abundance still needs to be clarified.
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. Morriss, Royal Holloway This study compares the ingestion of microplastic by pelagic and benthic fish populations from two major UK catchment areas: 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 Polystyrene microplastic uptake and effects on feeding behaviour and reproduction in the cladoceran Daphnia magna
B. du Plessis, Université des 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 <5mm) on freshwater cladocera (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 and competition of MPs after 48 hours made us to find out that the daphnids 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. Saddler, The University of Birmingham / Environmental Sciences 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 (Jenme, 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 (filters) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2-3 mm) to D. galeata (1.3-2.0 mm) which span 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 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 particle number) (Nasser, 2016). The hypothesis tested was that the size of microplastics particles preferentially taken up by the organisms will scale with organism size, due to differences in their gut sizes and filter feeding capabilities. We assessed the uptake, accumulation, and depuration of the microplastics in Daphnia species using stereomicroscope (Nikon SMZ800) measurements. Image analysis approaches (ImageJ and Matlab) were utilised to calculate gut area, and pixel density within the gut, in an effort to quantify particle uptake. This was correlated with fluorescence measurements using fluorescently-labelled microplastics, corrected for the average fluorescence per particle. Rapid accumulation in the gastrointestinal tract was observed after exposure to all particle sizes in D. magna, with the smaller particle sizes being detectable in the guts of neonates of all three species. The comparative uptake and effects of polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU190 Determination of microplastics in mackerel stomachs by enzymatic digestion and µFTIR
G. Grueiro-Noche, Universidade da Coruña / Grupo Quimica Analítica Aplicada (QANAP); V. Fernández-González, J.M. Andrade-Gardu, Universidade da Coruña / Grupo Quimica Analítica Aplicada (QANAP); P. Llorente-Mahía, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Quimica 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 constitute 60-80% of marine litter. A particular fraction of plastic debris are microplastics (<5 mm)fibres). 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 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 certain species 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 PCIN-2015-170-C02-01, Funded by FEDER, BASEMAN (JPI Oceans) and, project CTM2016-77945-C3-3-R (ARPA-ACUA).


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. Loeber, I. Schrank, C. Leforsch, University of Bayreuth / Environmental Science 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 (Jenme, 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 (filters) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2-3 mm) to D. galeata (1.3-2.0 mm) which span 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 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 particle number) (Nasser, 2016). The hypothesis tested was that the size of microplastics particles preferentially taken up by the organisms will scale with organism size, due to differences in their gut sizes and filter feeding capabilities. We assessed the uptake, accumulation, and depuration of the microplastics in Daphnia species using stereomicroscope (Nikon SMZ800) measurements. Image analysis approaches (ImageJ and Matlab) were utilised to calculate gut area, and pixel density within the gut, in an effort to quantify particle uptake. This was correlated with fluorescence measurements using fluorescently-labelled microplastics, corrected for the average fluorescence per particle. Rapid accumulation in the gastrointestinal tract was observed after exposure to all particle sizes in D. magna, with the smaller particle sizes being detectable in the guts of neonates of all three species. The comparative uptake and effects of polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU192 Phptochemical fragmentation of freshwater microplastics under UV irradiations
V. Verney, CNRS - ICCF / Photochimic-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 photoaging of the material. This scenario is accompanied by a physical fragmentation into very small sizes, and the chemical functionalization due to the photo-oxygenation 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 plastics fragments (Polystyrene, Polypropylene and Polylactic 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 (melthography, 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
J 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 physichem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and thus have the highest potential to contribute to environmental contamination. The lability of polymers in the environment is due to the 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 physichem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physichem 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 USEPA) 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 about potential hazards of microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus 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 distribution, swimming behaviors, 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. In Keywords: Microplastics, Sheepshead minnow, Behaviors, Gene expression

TU195
Assessment of the microplastic contamination in sediments from the French Atlantic coast
N. Phuong, Université de Nantes; L. Poirier, Université de Nantes / MMS; f. lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Molecules of Le Mans IMM UMR CNRS; M. Déniel, Institut des molécules et matériaux du Mans; A. Kamar, A. Zaakoub-Vergnoux, Université de Nantes / MMS

The ubiquitous presence of MPs has been demonstrated by scientists for recent years. They are detected in all environmental compartments: air, freshwater, aquatic organisms and particularly in marine ecosystems. Sediments are known as the most important accumulated environmental compartment. Thus, the aim of this study was to assess the MP contamination in sediment from the French Atlantic coast. Sediments were sampled at three locations (Pays de la Loire region, France) and in two seasons: October 2015 (beginning of autumn) and March 2016 (beginning of spring). Firstly, different protocols (with or without digestion step) were tested according to the literature and the most appropriate was validated spiking 25 g of sediment samples in triplicates with 4 different MP types: polyethylene (PE), polypropylene (PP), polivinil chloride (PVC) and polyethylene terephthalate (PET). MP extraction from sediments was performed using milliQ-water combined with centrifugation technic. After a filtration step, MPs were detected and identified directly on the membrane filters using µFTIR spectroscopy in reflection mode. Then, a test was performed in order to determine the replicate number required to obtain a 90% probability representativeness of the whole sampled sediment. For the sediment collected in the field, MPs were found in each location and for each season. Average levels ranged from 38 (± 46.72) to 102 (± 105.37) MP kg per kg of dry sediment (N = 10; 250 g). Ten different compositions of MPs were defined by µFT-IR with a high proportion of PE and PP, 38 and 23% respectively. Five MP types (PE, PP, PVC, polystyrene and polyester) represented more than 90% of MPs. Interesting information of MP characteristics supported the explanation of the source and also the long-time passed in marine environment. None of significant differences were found among six sample groups. This work provides the first dataset on the level of contamination in sediments from the French Atlantic Coast.

Derivation, Validation and Implementation of Environmental Quality Benchmarks (P)

TU196
Challenges in implementing legal frameworks for assessing water quality : the cases of the EU and Swiss approaches
N. Chévez, M. Milano, E. Bernard, University of Lausanne / Faculty of Geosciences and Environment

Human activities have a great impact on river quality. Monitoring programs show that multiple chemicals are present in water and that physico-chemical properties and runoff/dissolution capacities of rivers evolve due to climatic changes. These changes can affect the aquatic ecosystems as well as the amount of useable water. It is therefore crucial to evaluate the state of river systems using a holistic approach. The European Commission established a framework to highlight rivers’ ecological deficits and to enhance regional or local water management plans. In Switzerland, such a framework is currently under development. In this study, we compared both procedures and implemented them in a Swiss catchment dominated by agricultural activities. The goal was to identify challenges linked to the application of these approaches. Both frameworks are based on the hypothesis that not all sections of the river meet a good environmental state and that the latter deteriorates as tributaries and wastewater discharge flow into the main riverbed. Chemical issues and water quality changes due to hydro-climatic variations and management strategies were also pinpointed. Both frameworks are thus able to highlight the main problems of the river and are consistent with each other. They are thus useful tools to survey the spatial and temporal evolution of rivers quality. However, several challenges remain, especially regarding the strategies to monitor and analyze chemicals, the definition of target values and conditions, the evaluation and integration of human-induced-pressure, and the overall evaluation of the rivers state. Development of integrated indicators is seen as a potential solution to explore river health and to provide efficient restoration measures by water managers.

TU197
Updating the Environmental Quality Standards for the EU priority substance chlorpyrifos
M. Wiild, Ecotex Centre CH / Ecotoxicology; M. Casado-Martinez, Centre Ecotex; M. Junghans, B.J. Ferrari, Centre Ecotex EAWAG/EPFL; I. Werner, Ecotex Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

Chlorpyrifos (CPF) is widely used as an active ingredient in insecticides. Since 2005 CPF is a priority substance under the EU Water Framework Directive (WFD) with an AA-EQS of 0.033 mg/L and a MAC-EQS of 0.1 mg/L. The aim of this study is to update the EU environmental Quality Standards (EQS) in line with the new current data and the WFD method for EQS derivation published in 2011. Both AA-EQS and MAC-EQS decreased by more than one order of magnitude. The original AA-EQS was not derived based on available chronic ecotoxicity data but was set as MAC-EQS divided by a factor of 3, while the revised value of 0.00046 mg/L is based on a NOEC for A. bailey from the EESA authorisation dossier and was an assessment factor (AF) of 10. The original MAC-EQS was derived from mesocosm NOECs using an AF of 1. The revised MAC-EQS of 0.0044 mg/L is based on an HC5 from a species sensitivity distribution (SSD) for crustaceans and insects using
The lowest eligible AF of 5. The SSD reveals branchiopod 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 collected during the chronic bioavailability campaigns for sediment sources with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data show that the amphipod H. azteca 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_{sed,AF} 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_{sed} from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQS_{sed,AF} of 0.016 µg/kg dw. Without this AF, the EQS_{sed,AF} would be in the same order of magnitude as the calculated EQS_{sed,AF}. 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; J. Chowdhury, International Lead Association / Senior Scientist -Environment Lead (Pb) is a chemical for which one EQS has been set and is applied across all countries. Following the introduction of 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 European-wide bioavailable lead EQS of 1.2 µg L⁻¹ (EQSbioavailable) was undertaken against regulatory freshwater monitoring data from six European member states and FOREGS database. A tiered approach was employed to compare measured Pb concentrations with the EQSbioavailable. Equipped 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-met, 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 concentration (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 Pb concentrations in European freshwater, as tested with regulatory monitoring datasets is relatively low. Of 8257 samples from 443 sites taken from regulatory monitoring records from six member states 61 samples showed an exceedance at Tier 3 (0.7%) with a maximum RCR of 5.32. For the FOREGS dataset, 2 % of the sites assessed assessed had a concentration greater than or equal to the EQS, and at tier 3, 1 site had a concentration failing to meet the EQS. The greatest frequencies of such sites are worked upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon concentration (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 Pb concentrations in European freshwater, as tested with regulatory monitoring datasets is relatively low. Of 8257 samples from 443 sites taken from regulatory monitoring records from six member states 61 samples showed an exceedance at Tier 3 (0.7%) with a maximum RCR of 5.32. For the FOREGS dataset, 2 % of the sites assessed assessed had a concentration greater than or equal to the EQS, and at tier 3, 1 site had a concentration failing to meet the EQS. The greatest frequencies of such sites are worked upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon concentration (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 in European Freshwaters: are they a risk? A regulatory assessment accounting for bioavailability

**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 mentally relevant parameter and measured Pb concentrations from freshwater streams and rivers across Europe. In Tier 1 measured dissolved Pb concentrations were directly compared against the EQSbioavailable. In Tier 2, Bio-met, 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 concentration (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) have 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.

**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 (EQSbioavailable) of 1.2 µg L⁻¹ has been set under the European Commission directive 2014/50/EU for application across all countries in Europe. In the present study, a tiered approach was applied to undertake a compliance assessment of the EQSbioavailable 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 EQSbioavailable. In Tier 2, Bio-met, 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 concentration (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) have 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 modeling (P)**

T. Jager, DEBox 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 modeling framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has since subsequently gained a large user community. Furthermore, the model is receiving increasing interest from the regulatory field 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 comprehensive guide to the GUTS framework.

**TU201** Modelling survival under chemical stress. A comprehensive guide to the GUTS framework

W. Knepper, DEBox Research / TU Dresden - Institute Meinecke's Environmental Risk Assessments; K. Billau, WSC Scientific GmbH / Dept Efate  Modelling; K. Billau, WSC Scientific GmbH In recent years mechanistic effect models including GUTS and DEBTox have been successfully used in the aquatic and terrestrial risk assessment of pesticides. These models offer the advantage that results from laboratory studies, usually conducted with constant exposure, can be translated to time variable exposure, which is more typical under field conditions. At present these models consider a threshold beyond from regionally relevant water chemistry data (99.3%). Sites where elevated ambient background levels of copper are combined with very high bioavailability, principally when the waters have low DOC concentrations, are those most likely to be at risk due to copper exposures.
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 when the specific shape of a dose-response curve 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 sole (Solea 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 - Iresta / UR EABX; V. Loizeau, IFREMER / UR Biogeochemistry and Ecotoxicology; L. Pecquerie, IRD / UMR LEMAR; P. Labadie, UMR CNRS EPOC; Université Bordeaux / UMR 5805 EPOC; G. Mouton, Université de Montpellier / Chemistry; H. Budzinski, CNRS / UMR 5805 EPOC; J. Lobry, Iresta / UR EABX

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. Models based on the Dynamic Energy Budget (DEB) theory are relevant to predict individual and population level consequences. 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 such 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 preys in the wild. Indeed, diet reconstruction from stomach contents and isotope data provided us with contrasted pictures. We propose a series of conclusions for the interpretation of DEB predictions in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). Within a DEB approach prioritizing sources of variability provided new insights on the differential bioaccumulation between toxicant families in a key flatfish resource.

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 body size and short life cycle make them convenient test organisms in ecotoxicity studies. Beside acute toxicity, multiple works in the past focused on chronic life history effects of chemicals in copepods. Unfortunately, we usually lack a mechanistic explanation of observed effects and its consequences for realistic laboratory and field extrapolation. A mechanistic approach rooted in Dynamic Energy Budget (DEB) theory can help to evaluate sublethal toxicity data in terms of effects on the energy household of an animal. Although DEB models for new species are usually easily parameterised, the copepod life history shows distinct deviations from the ‘standard DEB model’ requiring further investigation. While some authors presume metabolic acceleration from birth until puberty, others suggest a von Bertalanffy growth curve which is truncated at the final molt. In this study we parameterised the two typical DEB models – ‘abp’ (metabolic acceleration from birth to puberty) and ‘sbp’ (standard von Bertalanffy growth from birth to puberty) for the harpacticoid copepod Nitocra spinipes to investigate metabolic acceleration in copepods. As no high-quality data on length over time were available for N. spinipes, we performed a growth experiment over 28 days. Additional data from literature were used to aid the parameter estimation. Submodels for food (Holling’s type II functional response) and temperature dependency (Arrhenius temperature correction) were calibrated on development time and reproduction data. While isomorphic growth is commonly assumed in DEB studies, it does not hold true for N. spinipes which grows more slender in the course of its development. Hence, we used the square root of the top view area as a length measure to scale with the cubic root of structural volume in length-to-volume conversions. Both models abp and sbp showed good fits to the given data. Overall, abp predicted the data slightly better compared to sbp with a mean relative error of 0.063 vs. 0.076 in sbp. However, we do not regard this difference clear enough to unequivocally confirm or reject metabolic acceleration in copepods. More detailed data on N. spinipes and other copepods are needed to reveal the most accurate model for the copepod life history. That said, both models are promising tools for the evaluation and extrapolation of toxicity data in N. spinipes.

TU205 Grey seal physiological and environmental change

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Marine 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 performance during the different life stages and food availability, quality and contamination. 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 such 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 preys in the wild. Indeed, diet reconstruction from stomach contents and isotope data provided us with contrasted pictures. We propose a series of conclusions for the interpretation of DEB predictions in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). Within a DEB approach prioritizing sources of variability provided new insights on the differential bioaccumulation between toxicant families in a key flatfish resource.

TU206 Evaluation of thermal stress on Daphnia magna using oxidative stress and life-history trait parameters

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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 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 elevated temperature. The higher ROS level and attendant stress in D. magna exposed to elevated temperature could cause damage to the organism. Lower lipid peroxidation (LPO) level at elevated temperature under prolonged exposure suggests that antioxidant enzymes successfully prevented ROS-mediated damage. In addition, exposing D. magna to elevated temperature significantly shortened time to first brood, brood size, and body length, but induced significantly higher male production (p < 0.05). Reduced body length at elevated temperature indicated the significant influence of temperature on D. magna life history traits. Moreover, the Cu accumulation in tilapia was estimated more energy into defense mechanisms rather than growth and reproduction to cope with the thermal stress. Moreover, a multi-generation study was performed to evaluate multigenerational effect of elevated temperature on D. magna.

TU207 Transport-protein metal binding links uptake biodynamics for predicting copper in tilapia

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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 μg⁻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 h⁻¹ was also significantly greater than MAP 0.086±0.001 ml g⁻¹ h⁻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 tends 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
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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 nucleic acids 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 livers 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 biologically detoxified fractions (BDM) in livers 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 found to vary widely in exposed fish than in reference fish, with Cd (x6) 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 copper exposure, consistent with a threshold toxic response to 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)
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Acetylcholine 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 synapses overstimulates muscarinic- and nicotinic-type receptors. These receptors are found in most organs of the body, thus multiple adverse outcomes may result. Moreover, a wide variety of chemicals including organophosphates, carbamates and some high nitrogen compounds, can inhibit AChE. Thus, the impact of AChE inhibition is large, yet relatively little research has been focused on developing related adverse outcome pathways (AOPs) or a network for this molecular initiating event. This presentation focuses upon the construction of adverse outcome pathways that result from AChE inhibition in zebrafish (Danio rerio). We performed a comprehensive review of the literature to identify studies and datasets that could be used to construct an AChE AOP. Adverse outcomes include seizures, impairment of the retina architecture and behavioral changes. Preliminary AOPs for these outcomes will be presented with references to the studies that support the AOP, and identification of data needed for quantitative AOP development.

TU210
Development of a Novel Quantitative Adverse Outcome Pathway Predictive Model for Lung Cancer
T. Hill, US EPA NHEERL/ISTD/CB / ORD NHEERL Integrated System Toxicology Division; R. Conolly, US EPA RTP

Traditional methods for carcinogenicity testing are resource-intensive, retrospective, and time-consuming. An increasing testing burden has generated interest in the adverse outcome pathway (AOP) concept as a tool to evaluate chemical safety in a more efficient, rapid and effective manner that better directs resource utilization. A central premise of the AOP concept is that pathway progression from the molecular initiating event (MIE) implies a definable “response-response” (R-R) relationship exists between each key event (KE) that drives the pathway towards the adverse outcome. Computational description of these R-R relationships in a quantitative AOP (qAOP) enables dose-response consideration of probabilities and uncertainty, as well as flagging of special at-risk populations or sentinel species. The qAOP also provides a platform to utilize early genomic and in vitro data streams for rapid, low-cost, intensive testing as well as the development of high-level qAOPs that inform the level of risk. This poster describes a novel AOP/qAOP for lung cancer in the mouse from the MIE of CYP2F2-specific formation of reactive metabolites, advancing through KE for protein/nuclear acid adducts, diminished CC10 capacity and hyperplasia of CC10 deficient ClB cells, and culminating in the adverse outcome of mixed-cell tumor formation. The qAOP is independent of route of exposure and grounded in overlapping mechanistic events for naphthalene, styrene, ethylbenzene, isoniazid and flusulfonamide in the mouse. The qAOP modeling is supported by defined mechanistic relationships and quantitative data (PB-PK, dose-response and time-course) from archival data in peer-reviewed literature. Findings will include evaluation of data supporting the cancer qAOP, suitability for characterization of R-R relationships, and identification of data gaps or additional research as required. This approach supports international efforts on use of quantitative effect thresholds for adversity predictions and incorporation of novel data streams into the cancer risk assessment process. This abstract does not necessarily represent the views or policies of the U.S. EPA.

TU211
A combined PBTK and qAOP-modeling approach to assess the impact of dioxin-like compound (DLC)-induced embryotoxicity on recruitment failure in European eels
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The panmictic stock of the European eel (Anguilla anguilla) has seen a dramatic decline over the past several decades, and decline in recruitment as a result of maternally transferred contaminants has been proposed as one of several potential causes. In particular, dioxin-like chemicals (DLCs) have been identified as a class of chemicals of great concern for both European and American eels (Anguilla rostrata). DLCs bioaccumulate, are highly embryotoxic in many species of fish, and maternally transferred in artificially matured eels. However, to date researchers have been unable to locate a consistent relationship between DLCs and eel mortality in natural spawning grounds in the Sargasso Sea. As a result, accurate embryotoxicity data to identify the potential causative chemicals are unavailable. Therefore, this study aimed to (a) parameterize a physiologically-based toxicokinetic (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) 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 to gene transcription. In vitro luciferase reporter gene assay using transfected COS-7 cells with embryo lethality across nine species of fishes exposed to DLCs. 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. Our integrated 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
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The pituitary gland is a major regulator of reproduction, 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 17β-ethynylestradiol (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 (fshb) mRNA levels. These results motivated us to expand our studies by developing an in vitro test system.
system using pituitary cells isolated from coho salmon and previtellogenic female rainbow trout. Preliminary studies were performed to optimize culture conditions and to establish the time course of fshb and LH [lhb] subunit gene expression with and without addition of endogenous sex steroids (estrogen [E2] or 11-ketotestosterone). These initial studies suggested culturing with and without E2 was valuable as it could mimic the (+) feedback effects on LH that is observed from in vivo studies. After optimizing assay conditions, a suite of 12 contaminants and other hormones was evaluated for their effects on fshb and lhb gene expression. Each chemical was tested at 4-5 different concentrations up to solubility limitations in cell culture media. Results indicated more chemicals altered LH synthesis than FSH. The more potent chemicals were estrogens (EE2) and aromatizable androgens (testosterone), which induced lhb. The estrogen antagonist 4-OH-tamoxifen decreased the E2-stimulated expression of lhb. Among several SSR1-tested, the sertraline metabolite nosertraline was notable for both increasing fshb synthesis and decreasing the E2 stimulation of lhb. These results indicate that diverse types of chemicals can alter gonadotropin production in fish. Further, we have shown that pituitary cell culture is useful for screening chemicals with potential endocrine disrupting activity and can support quantitative adverse outcome pathway testing. Supported by EPA-STAR grant R835167.


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. Alvarez, Z. Weng, J. Diewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; J. Drielsma, Euromines

The framework will be applied in a workshop with project external stakeholders and the outcome of its first application during the stakeholder workshop. Supported by EPA-STAR grant R835167.

TU215 The relevance of the end-of-life stage for the environmental impact of batteries J.F. Peters, Karlsruhe Institute of Technology KIT / Helmholtz Institute Ulm HHI; M. Weil, University of Modena and Reggio Emilia / Department of 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 separative 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 (re-used mounted system), a hybrid aqueous ion battery (AHIB) and a vanadium redox flow battery (VRFB), all with the same net storage capacity. 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 recovering 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.

TU216 Battery recycling efficiencies and their influence on the life cycle impacts of batteries K. Boonen, A. Van der Linden, VITO

The EU Batteries Directive sets the minimum recycling efficiencies for waste batteries as a percentage of their average weight. In the light of the circular economy, it may be argued that, in addition to the quantity, it is important to consider the specific materials that are recycled, the quality of the recycled fractions and their potential use. The Public Waste Agency of Flanders (OVAM) asked VITO to assess the effect of these factors. In this study, the environmental impact of the end of life is compared for different battery recycling routes. Furthermore, the impact of the rest of the life cycle of disposable and rechargeable batteries is calculated to put the impact of the end of life into perspective. A number of potential improvement options, such as a higher collection rate, higher functional recycling and a shift to different types of batteries, are evaluated.

TU218 New and Reconditioned Electrical and Electronic Equipment. How does the environment performance? M. Pini, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering; P. Neri, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering DISMI; R. Gamberini, B. Rimini, F. Lolli, University of Modena and Reggio Emilia; A. Ferrari, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering

The scope of this study, carried out within the LIFE12 ENV/IT001058 WEEEnodels, was to compare the environmental performance of the life cycle of new electrical and electronic equipment (EEE) and the reused one through the Life Cycle Assessment methodology. Both attributional and consequential LCIs (Life Cycle Impact Evaluation) models have been developed to implement the database that has been considered for each EEE group, assuming that it generates the same environmental damage of the other products belonging to the same category. In particular, the following representative products have been selected: refrigerator (R1), washing machine (R2), cathode ray tube (CRT) (R3), laptop (R4) and fluorescent lamp (R5). In addition, lower performance of reconditioned EEE has been taken into account. Different set of replaced components have been evaluated in order to understand which determines the best solution. Scenario A represents the set of replaced components, which damage more frequently. Scenario B is just an alternative set of replaced components. The environmental comparison between new and reused EWE, adopting attributional LCI modelling, showed that Scenario B produces a damage decrease for all EWE categories. Moving on the consequential LCI modelling, the environmental comparison highlighted for both scenarios a considerable damage reduction for the reused EEE respect the new one. Furthermore, for the reused R1, R2, R3 the analysis of results carried out environmental credits. This is due to the avoided burdens associated to the manufacturing of the new EEE, since the system boundaries have been enlarged underlining the avoided production of those products. Attributional and consequential LCI modelling performed different LCIA results. Following the methodological guidance for the identification of the most adequate LCI modelling framework presented by Laurent et al., 2014, it would recommend to adopt consequential LCI modelling. But we suggest to LCA practitioner to focus also the attention on the request of who commissioned the project, which often in the waste field are local administrations. Generally, they wants a snapshot of the real effects that waste management policies provoke on human health and environment. For this reason, attributional LCI modelling would be the proper LCI modelling to achieve this scope. Considering this LCI modelling the Scenario B determines the
TU219 The impact of European consumption of household appliances: insights from the LCA of efficiency measures and expected trends

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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 emissions. The aim of the study was to provide insights 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 heating analysis with ELCI impact assessment model confirmed the well-known relevance of the use phase of energy-related products, where the efficiency of products and consumer behavior appear to be the two factors determining the BoP impact. Results of the scenarios assessed show for most of the categories a reduction of the overall impact compared to the baseline scenario. The reduction is more important for categories like e.g. GWP due to the improved energy efficiency of products. Regarding the environmental benefit 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 HTPc, FETP, 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. Nishiijima, National Institute for Environmental Studies; S. Kagawa, Kyushu University; M. Oguchi, K. Nansai, National Institute for Environmental Studies

In this study, we evaluated environmental burdens from consumer durables, product lifetime is a key factor and most of the previous studies used average lifetime or lifetime distribution with a focus of engineering durability (Müller 2006; Kagawa et al., 2011; Nishiijima, 2016). These product lifetime modelling techniques did not explicitly treat a relationship between product replacement and consumer behaviour. Whereas, the product replacement modelling techniques based on the economic lifetime utility theory have been developed in economics and marketing fields (Schiraldi, 2011; Melnikov, 2013). It is beneficial to apply the economic product replacement models to environmental research. This study attempts to use the product replacement model for evaluating economic and environmental effect of polices for consumer durables. As a case study, we focused on air conditioners and analyzed the economic and environmental 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 logit 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. Nakamoto, 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 and consumer behavior that maximizes utility level over time, we were able not only to specify the replacement purchase rates on a dynamic 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 replacement decision and purchase. In this study, we used a DDC 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 in 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. For the results of this study show that revising Japan’s car inspection system has the potential to cause a major turnaround in the current automotive purchasing behavior on the short-term, it is necessary to investigate new materials and configurations of EV batteries. To this end, lithium-sulfur (Li-S) batteries are 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 are solved, above all when considering their fitting in a circular economy; 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 their 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 potential 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 ecosizing of a “vapour and air barrier membrane - insulator” system, in a cradle to cradle approach lasting, but also respectful of the Chemical Regulating of the Toxics Technical Engineering - PEPs; M. Getlicherman, Derbigum; B. Colson, Sioen Felt & 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. In this study, we have investigated the 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 + renewable materials), with the potential environmental impact on its whole life cycle. The solution can be used in both new construction and future 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, as can be seen in the bottom. Due to its 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 Derbiskin®. 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 Platforms 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-NetPlus Infravation 2014 Call, the project BioRePavation has been developed, which aimed to analyse three alternative biomaterials to be included in high recycled asphalt content mixtures to help increase recycling rates in a European case study. Within the ERA-NetPlus Infravation 2014 Call, the project BioRePavation was carried out to determine whether the use of recycled asphalt mixture in high recycled material has to be treated and new component is already carried out: the Derbiskin®. 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 Platforms and subsidized by the Walloon Region (BE).

TU226
Circulation and flow of materials and their environmental performance in the building and the various elements are recovered and valued in a cradle-to-cradle perspective. A first step is already carried out: the Derbiskin®. 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 Platforms and subsidized by the Walloon Region (BE).

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 one of the key actors in this process in their pursuit of offering 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 studies. 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 include life cycle assessment (LCA) to assess the environmental impacts of building and construction materials.

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 four 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 of the earth’s safe operating space. For this reason, consequential life cycle assessment (CLCA) provides suitable tools for understanding these changes. Our main goal is to create a methodological framework that enables the assessment of CE strategies across scales within the planetary boundaries. Two assessment levels will be considered, i.e., cities and products/sectors. The framework will be applied and tested through an analysis of a case study: the city of Leuven in Belgium.

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 support decision making in water treatment processes.
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 available ones. Recovery of CFC flocculants from iron sludge is applied in the drinking water purification or waste water treatment looking 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 high 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 biogdredation, 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 optimize compound removal from wastewater, is recommended. In this study LCA has shown to be an effective tool to evaluate the direction of research within the 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, CETAlqua / MASE; M. Amores Barrero, CETAlqua, Water Technology Centre; D. Marin, CETAlqua, Water Technology Centre / Environment and Socioeconomics; M. Issa, CETAlqua Water Technology Centre / MASE; M. Termes, CETAlqua; M. Ruiz Mateo, CETAlqua 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 challenging, limited by several constraints such as the availability of information on the specific composition of the waste, the availability in time and space of adequate quantities of waste as well as 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 beneficial only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems will be the energy consumption of the territories and the influence of future energy policies, the performance of the biotechnologies will very likely depend on energy 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 overtoning different types of waste remain challenging.

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 efficient design and operation of the industry to produce value in the most circular and socioeconomically optimal way. A holistic approach is taken into account in order to achieve at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCAs of biotechnologies with analysis of productivity, efficiency and socioeconomics. 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 biofereiny ecoscouch 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 and processes) added up to the territory level. A feedback loop is included between the modules of biogas energy assessment and the food 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 influential 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. Iten, K. Kelling, M. Stucki, Zurich University of Applied Sciences / Institute of Sustainable Development Science and Technology 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 of adequate quantities of waste as well as 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 overtoning different types of waste remain challenging.

TU232 Evaluation of nutrients and energy recovery technologies through Life Cycle approaches M. Ruiz Mateo, CETAlqua Water Technology Centre; M. Calvet, CETAlqua / MASE; S. Lopez, CETAlqua Water Technology Centre / Santiation; M. Issa, CETAlqua Water Technology Centre / MASE; Y. Lorenzo-Toja, CETAlqua, Water Technology Centre; D. Marin, CETAlqua, Water Technology Centre / Environment and Socioeconomics Traditional 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 value in the most circular and socioeconomically optimal way. A holistic approach is taken into account in order to achieve at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCAs of biotechnologies with analysis of productivity, efficiency and socioeconomics. 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 biofereiny ecoscouch 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 and processes) added up to the territory level. A feedback loop is included between the modules of biogas energy assessment and the food 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 influential 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.
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 these two innovative treatment processes, which are both: (1) unconventional and (2) conventional types 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 fertilisers 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. These costs embrace the capital 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.

TU234 Environmental, social and economic challenges towards a bio-based economy: the STAR-ProBio project, Sustainability Transition Assessment and Research of Bio-based Products

P. Hajicek, Unitel Sapienza University of Rome; S. Righi, University of Bologna / Physics; E. Merloni, University of Bologna; L. Summerton, University of York; L. Ludu, Technische Universität Berlin; A. Koutinas, Agricultural University of Athens; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; S. Ugarte, SQ consult; J. Golaszewski, of Athens; S. Majer, DBFZ, Deutsches Bioenergie-Institut; P. Galassi, Università di Bologna / Dipartimento di Chimica G Cianciam; E. Tagliavini, Università di Bologna / Dipartimento di Chimica G Cianciam; Alma Mater Studiorum EU wine production accounts for some 60 percent of worldwide output, with France and Italy being the largest wine producer countries in the world (Gaeta and Corsinovi, 2014). The wine industry influences the environment with the use of soil, water, energy, fertilizers and pesticides. In addition it produces liquid and solid organic waste that has to be managed in the proper manner in order to minimize environmental impacts. In recent years, some innovative technologies have been proposed for the valorization of winery waste and by-products (i.e. grape marc, grape seeds, vinification lees, etc.) (Devesa-Rey et al., 2011). VALOBAL is a research project funded by Emilia Romagna Region (Italy) which aims to valorize wine industry by-products. Its focus is the development of an integrated strategy for the transformation of waste from the whole oenological supply chain into high added-value products such as polymers, base chemicals, and molecules for the nutraceutical, cosmetic and agrochemical industries. In this framework, a novel experimental process for the valorization of wine lees and sewage sludge is carried out. These winery residues are subject to anaerobic acidogenic fermentation in order to produce volatile fatty acids (VFAs), which in turn are used to feed a mixed microbial community (MMC) able to accumulate polyhydroxyalkanoates (PHAs) granules as carbon and energy intracellular reserve. The last step consists of PHAs extraction using dimethyl carbonate (DMC). Life cycle assessment is applied to calculate and compare the environmental impacts related to the production of one kg of PHA, in comparison with several alternative sources, and to identify hotspots in the life cycle of the biogas industry. The results of this research are of great importance for the development of a sustainable wine industry. The research also shows the potential of anaerobic digestion for the production of biogas-based products and their high economic and environmental benefits.
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 the authors of EU are not the only ones to claim benefits from recycling. No, recycling waste streams in other life cycles, does 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, with 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 barriers and how 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 of scale-up, complex market of substituted products, different geographical location of the technology implementation. One key aspect is that the adopted perspective directly influences the results in terms of environmental preference of the innovative technology, and as such, the benefits of circularity solutions needs 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. Dagilutė, Vytautas Magnus University / Environmental Science Department; A. Musteikytė, 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 wasteage has an enormous negative impact on the global economy and food availability and contributes to major environmental impacts. EU's programme "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 indicates, 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 amounts 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 this issue, we conducted a survey among the customers of the restaurant. The survey showed 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 the clients say that they do not know how to take responsible action to take away the food. Most of restaurant consumers 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, Universidade de Santiago de Compostela; S. González-García, University of 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 the world agenda. The 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 study 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 considered as a first step towards understanding the influence of the eating habits in the Atlantic diet. 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-2014-14084).

TU240 Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes?
I. A. Chang, SKU Leuven / Department of Materials Engineering; K. Van Acker, SKU Leuven / Materials Engineering; J. Eyckmans, SKU 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 producing a wider access to goods and services, using goods and services more intensively, using the 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, sharing goods can be seen as a means to increase consumer awareness of environmental impacts of the goods produced. In this research, the sharing of goods can be seen as an agent that influences people in many ways, with corresponding changes to market dynamics. This research consists of a review of studies into the sharing economy, and suggests how consequential LCA can be used to give a more detailed assessment of the environmental impacts. Particular attention is paid to how the behavioural changes in consumption should be accounted for in an LCA applied to the sharing economy.

Innovative techniques for enhancing and monitoring microbial activities for in situ remediation of contaminated sites (P)
TU241 Effects of plant growth and organic carbon addition on DDE degradation in soil
M. Cardoni, National Research Council of Italy / Water Research Institute; F. Mitton, University of Mar Del Plata; M. Di Lenola, National Research Council of Italy / Water Research Institute; L. Patrolecco, Water Research Institute-National Research Council / Water Research Institute; N. Ademollo, F. Spataro, National Research Council of Italy / Water Research Institute; K. S. Miglioranza, University of Mar Del Plata / Laboratorio de Ecotoxicologia y Contaminacion Ambiental; Instituto de Investigaciones Marinas y Costeras; M. Gonzales, University of Mar Del Plata; P. Brenni, National Research Council of Italy (CNR) / 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”- DDE) 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 set 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 effects of the treatments on the growth, biomass, and transpiration rate of tomato plant 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.


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 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 poplar leaf biomass produced for syngas biogasifying, using biomass collected from a plant assisted bioremediation area located in a multi-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-plant 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 grow and transform the bioremediation techniques 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 an unexpected capacity 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 experiment of plant-assisted bioremediation.

TU245 Are PCB half-lives obtained in rhizoremediation experiments reliable? Pitfalls in experimental design and suggested guidelines for conducting the experiments E. Terrzaghi, University of Insubria (CORS) / Department of Science and High Technology and Forest Biology (IBAF); E. Terzaghi, University of Insubria (CORS) / Department of Science and High Technology and Forest Biology (IBAF); E. Dottori, University of Insubria (CORS) / Department of Science and High Technology and Forest Biology (IBAF); E. Dottori, University of Insubria (CORS) / Department of Science and High Technology and Forest Biology (IBAF); E. Dottori, University of Insubria (CORS) / Department of Science and High Technology and Forest Biology (IBAF); E. Dottori, University of Insubria (CORS) / Department of Science and High Technology and Forest Biology (IBAF).

In the last two decades bioremediation technologies have become ever more important as a sustainable alternative to traditional remediation techniques. In particular, there has been an increasing attention on rhizoremediation techniques, employing plant roots and their associated microorganisms to enhance the degradation of organic contaminants in soil. Many short-term laboratory/greenhouse experiments and long-term field trials have been conducted to estimate the most suitable plant species and environmental conditions that stimulate and favour microbial activities in the degradation of Polychlorinated Biphenyls (PCBs). Recently, an attempt to extrapolate rhizoremediation half-lives (rizo-HLs) for the ten PCB families from these studies has been made (Terraghi et al., 2018) providing important data for multimedia fate models that aim to predict the time needed to achieve regulatory thresholds in a PCB contaminated site where rhizoremediation techniques are applied and therefore to draw up its remediation plan. However, many of the studies available in the literature (more than the 80%) were not correctly set up to allow the calculation of PCB rizos-HLs and could not be considered. In particular the main pitfalls in the experimental design referred to the type of chemicals (single congeners vs. mixture), contamination (spiked vs. field treatment), the experimental design (field vs. experiment with sterilized greenhouse or field), the experimental time, the set-up of appropriate controls and replicates as well as the analytical and microbiological techniques adopted. The present work aims to 1) list and discuss the main pitfalls in the experimental design of previous and current rhizoremediation experiments and 2) propose guidance to perform appropriate experiments to obtain comparable, accurate and useful data for rizos-HLs calculation. Moreover rizos-HLs will be presented and compared with those obtained with other approaches.


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. Hydrocarbons-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0×10^8 and 30×10^8 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.
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Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbial community selection are therefore pivotal to develop in-situ bioremediation techniques. In a perspective 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). The aim of our study was to evaluate the spatial correlations between environmental factors (pollutant fingerprints and soil physico-chemical properties) and the soil microbial community structure. More than 800 soil samples were collected in the SIN Brescia-Caffaro along a tridimensional geostatistically conceived grid, and were analyzed to estimate the soil hydrolytic activity, the physico-chemical features and the concentration of metals and 79 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. Our results suggest that the soil properties and the contaminant profile in the SIN Brescia-Caffaro shaped the structure of the residing bacterial communities, leading to hypothesize that it drove the selection of populations able to degrade the contaminants. The detection in the SIN Brescia-Caffaro soils of the <i>hph</i> gene, codifying for the biphenyl dioxygenase involved in the aerobic PCB degradation process, confirmed that they host an immediate biocatalytic potential for biobased remediation interventions. This study also highlighted the prospect of exploiting spatial patterns of bacterial diversity as proxies for monitoring polluted sites.

TU248
Laboratory-scale assessment of bioremediation of hydrocarbon-contaminated soil.
F. Diana, University of Milano - Bicocca; T. Stella, University of Milano-Bicocca / DISAT; M. Daghio, University of Milano - Bicocca / Department of Earth and Environmental Sciences; F. Pittino, University of Milano - Bicocca; R. Ferrari, A. Francioli, HPC Italia s.r.l.; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences

Recalcitrant hydrocarbons often persist in contaminated environments. Biological remediation strategies (bioremediation) are a widely used approach to remove hydrocarbons. This study focused on bioremediation of hydrocarbons contaminated soil from an industrial active site using biopiles. The site is contaminated by light and heavy hydrocarbons, the latter ones representing the most recalcitrant fraction. Bioremediation is a widely used solution to remove the residual contamination, but the size of the area and the economic/environmental costs of other technologies such as Dg&Dump. Biopiles will be built to treat the contaminated soil, air insufflation and nutrient addition will be considered to stimulate the aerobic biodegradation of hydrocarbons. In order to optimize this process, a lab-scale test was carried out and three different conditions were tested: natural attenuation (NA), addition of sawdust (SW) and bioaugmentation (BA). Hydrocarbon removal was investigated in each condition and on both the soil and the wastewater. The results demonstrated that the soil properties and the contaminant profile in the SIN Brescia-Caffaro shaped the structure of the residing bacterial communities, leading to hypothesize that it drove the selection of populations able to degrade the contaminants. The detection in the SIN Brescia-Caffaro soils of the <i>hph</i> gene, codifying for the biphenyl dioxygenase involved in the aerobic PCB degradation process, confirmed that they host an immediate biocatalytic potential for biobased remediation interventions. This study also highlighted the prospect of exploiting spatial patterns of bacterial diversity as proxies for monitoring polluted sites.

TU258
Italian field results of Enlabeled Lecithin-based Substrate used as ERD treatment of Chlorinated Solvents in groundwater.
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ELSMicroemulsion is a food-grade carbon that supports the treatment of a wide range of groundwater contaminants, including chlorinated solvents. ELS is acronym for Enlabeled Lecithin Substrate, a technology designed to create reducing conditions and to 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 promote reductive dechlorination. Microorganisms that can anaerobically acclimate to 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 tetrachloroethylen (PCE) and its metaboites 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 through 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 catabolites, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloroethane has also been observed in all the monitoring wells.

TU251 Cheesy whey effects on microbial communities in contaminated groundwater of an urban area

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Chlorinated ethenes (CE) are the second most ubiquitous contaminants worldwide. Herein we describe an urban locality Nový Bydžov (Czech Republic) where groundwater pollution was identified in private wells in 2007. The source of CE 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 polyhydroxybutyratate) 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, Sulfatothermus and vinyl chloride (VC) reductases vcrA and bvcA. In addition denitrifying bacteria were monitored by nirK marker and sulfate reducing bacteria by dsrA 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 organohalogen respiration increased and prevailed in higher concentrations. Moreover, high abundance triple reductase capacity for reductive dehalogenation of the CE contaminants. Specific markers are still being monitored in the treated groundwater and will be discussed together with physico-chemical results.

TU252 The Influence of Nanoscale Zero-valent Iron (nZVI) in Combination with Varying Organic Compounds (Modifiers) on Dehalorespiring Microflora

K. Markova, Technical University of Liberec / Institute for Nanomaterials, Advanced Technology and Innovation; D. Vikova, 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. Nosěk, 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 carbosymethyl 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 (lactate, glucose, cheese whey and polyhydroxybutyratate) as the electron donor for the bioreduction of oxidized species. In the present study, we propose that microbial binding of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination. 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 deadbacteria were found to have high adsorption (286-3324 µg/g of bacterial pellet) whereas live E. coli cell and other low abundant bacteria showed less adsorption (1-11 µg/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOS isolomers as the live component; 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.

TU254 Hexavalent chromium reduction in a biocathodic microbial electrolysis cell

G. Beretta, Politecnico di Milano / Civil and Environmental Engineering; A. Mastorogi, E. Sezenna, S. Sabrina, Politecnico di Milano

Groundwater is the environmental matrix most frequently affected by anthropogenic hexavalent chromium contamination. Due to its cancerogenic, 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 (BES) to stimulate bioreduction of Cr(VI). BES include a set of technologies based on the use of microorganisms that catalyse the reduction of hexavalent chromium (anode) into the biologically active component of a broad-spectrum microbial fuel cell, and inoculated with autotrophic cultur originale 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 solution was done by 16S rRNA gene sequencing. The acclimatization phase in the MFC allowed the formation of an electroactive biofilm on the electrode. A decrease in Cr(VI) concentration was observed at the end of the tests, both in the polarized reactor and in the OC reactor. However, the DES ensured higher removal efficiency than the pure chemical process. In addition, higher current values were measured in the DES compared to the abiotic control, thanks to the biofilm interaction with the bioanode. The results from microbial characterization showed that the bacterial community on the surface of the electrode was affected by the cathodic polarization, and it was different from the biomass on graphite in the open circuit system.

TU256 Enhancing Reductive Dechlorination Combined with In-Situ Chemical Reduction for the Remediation of a Heavy Contaminated Chlorinated Solvents Source Zone in South of Italy

The present site comprises an urban site where a historical Chlorinated Compounds-CHC (mostly PCE) contamination has been released in aquifer before injection, and with non-return valves corresponding to thirty contamination points. Contamination is present in shallow aquifer and was higher than 10 mg/L. The efficiency of the remediation is currently about 99.9%, removed more than 300 Kg PCE. The site characterization integrated with a MIP investigation to identify the plume. The plume has been addressed into four areas then a combination of In-Situ Enhanced Reductive Dehalogenation and In-Situ Chemical Reduction was selected to secure contaminant removal due to biodegradation, approaching the electron donors for PCE. This combination allows to a reducing ambient due to producing hydrogen which helps groundwater to reach an anoxic environment which is favorable for the microorganisms to degrade the PCE into the end product, ethylene. The first injection applied in a pilot scale (Phase 1) to calibrate the injection for the site conditions. Based on the successful result of this phase, the full-scale was considered and a two-step was applied in two steps. First step covered the northern part of the plume (area A) in the upgradient and main source zone (area B) which is the most contaminated area. In Area B also the vadose zone has been treated. After a year (step 2), the injection took place in area C near to the site boundary and in area D downgradient of the site. Due to PCE bioremediation we have production of daughter products to prevent the accumulation of these by producing an air sparging and soil vapor extraction plants have been installed in the site boundary to remove them from the soil vapor and aquifer. During the ERD we have observed methane production because of methanogenesis reaction, CH2M has decided to install a biofiltration plant to prevent any dangers for the residential areas nearby. The challenge this complex geology has been solved by using fixed injection points and injection valves nearby. The challenge this complex geology has been solved by using fixed injection points and injection valves nearby.

TU257 Bioelectrochemical sulfide scavenging from hydrocarbon contaminated marine sediments

M. Dohlo, University of Milano - Bicocca / Department of Earth and Environmental Sciences; E. Vauquoulet, Ghent University / Center for Microbial Ecology and Technology (cmet); C. Perri, University of Milano-Bicocca / Department of Earth and Environmental Sciences; M. Zoeter, Bicocca / Department of Earth and Environmental Sciences; I. Bona, L. Moretti, M. Cremonesi, CHZM Hill

The present site comprises an urban site where a historical Chlorinated Compounds-CHC (mostly PCE) contamination has been released in aquifer before injection, and with non-return valves corresponding to thirty contamination points. Contamination is present in shallow aquifer and was higher than 10 mg/L. The efficiency of the remediation is currently about 99.9%, removed more than 300 Kg PCE. The site characterization integrated with a MIP investigation to identify the plume. The plume has been addressed into four areas then a combination of In-Situ Enhanced Reductive Dehalogenation and In-Situ Chemical Reduction was selected to secure contaminant removal due to biodegradation, approaching the electron donors for PCE. This combination allows to a reducing ambient due to producing hydrogen which helps groundwater to reach an anoxic environment which is favorable for the microorganisms to degrade the PCE into the end product, ethylene. The first injection applied in a pilot scale (Phase 1) to calibrate the injection for the site conditions. Based on the successful result of this phase, the full-scale was planned for phase two and applied in two steps. First step covered the northern part of the plume (area A) in the upgradient and main source zone (area B) which is the most contaminated area. In Area B also the vadose zone has been treated. After a year (step 2), the injection took place in area C near to the site boundary and in area D downgradient of the site. Due to PCE bioremediation we have production of daughter products to prevent the accumulation of these by producing an air sparging and soil vapor extraction plants have been installed in the site boundary to remove them from the soil vapor and aquifer. During the ERD we have observed methane production because of methanogenesis reaction, CH2M has decided to install a biofiltration plant to prevent any dangers for the residential areas nearby. The challenge this complex geology has been solved by using fixed injection points and injection valves nearby. The challenge this complex geology has been solved by using fixed injection points and injection valves nearby.

TU258 Freshwater sediment enrichments to improve MFCs performance for in situ remediation application: a phylogenetic microbial characterization

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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 bioenergy 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 voltage were continuously monitored. DGGE, sequencing and qPCR techniques were used to investigate the EAM community. Moreover microbial α-diversity was calculated. The enrichment effect was evaluated both for the preenrichments and for the three components of MFCs (planktonic, biofilm and rod). Results showed that the MFC inoculated by Gen enrichment prepreculmer had better performance than the FeC one (shorter start-up time, lower anode potential, higher current density). The main source of variability resulted to be the kind of enrichment, both in the preenrichment 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 preenrichment and at the MFCs level (p < 0.05). Enrichment with FeC decreased the relative abundance of EAM and the microbial diversity. Previous studies show the need of a heterogeneous community dominated by EAM to improve the remove 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 13C 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 in line with the findings during the biodegradation. MCB was completely depleted upon addition of nutrient and CSIA results confirmed negligible C isotope fractionation under oxidative conditions. The catalytic toC gene, encoding for tolue oxygenase, 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 effective in the extended area.

TU260 Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area
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The biodegradation and bioremediation of chlorinated compounds in contaminated areas with multiple pollutant sources and different environmental conditions represent a big challenge to site owners. Therefore, a detailed chemical, isotopic and microbial site characterization (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 study aimed at gathering chemical, isotopic and molecular biological 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 presence of potential 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 Betahalobacter and Hydrogenophaga were predominant in 1,2-DCA and VC-contaminated groundwater, respectively. The functional characterization based on the quantification of catalytic genes encoding for reductive dehalogenases (PceA, TceA, VcrA, BvCa) and oxidative enzymes (etnC, etnE) will be accomplished (on-going analysis) as well as isotopic analyses.

TU261 Microbial ecology and ecosystem services: a key role for biotechnological applications
G. Lembo, ENEA CR / Department of Ecological and Biological Sciences; A. Signorni, ENEA-Italian Agency for New Technologies / Energy and Sustainable Development; V. Mazzucco Miniana, S. Rosa, A. Agostini, V. Pignatelli, ENEA-Italian Agency for New Technologies / Energy and Sustainable Development, Laboratory of Biomass and Biotechnology for Energy; M. Fenice, University of Tuscia / Department of Ecological and Biological Sciences; G. Pantano, ENEA CR / Department of Ecological and Biological Sciences; A. Dolcinova, ENEA CR / Department of Ecological and Biological Sciences; A. Cherchi, 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

The management and the remediation of large contaminated sites is a crucial issue for controlling the exposure to contaminants. Remediation of contaminated areas and groundwater as well as geological parameters of the site is needed. The aim of this work is, therefore, to develop a user-friendly software allowing assessment of bioremediation processes. The software enables an interpretation of input data, resulting in evaluation of potential for natural bioremediation at the contaminated sites. Suitability of conditions for bioremediation is simultaneously evaluated in this software. Moreover, data from one sampling round are only used to ensure widespread user availability, the program was created in Microsoft Excel. Actual data from the Novy Bydзov site were used to verify and demonstrate program’s functionality in this work.

Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations (P)

TU262 Evaluation of bioremediation potential in groundwater using newly-developed software
M. Presiничкя, 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; M. Marchesi, Politecnico di Milano

Bioresmediation is one of economic and effective environmental techniques being applied for the removal of different contaminants from the groundwater. To achieve a complete overview on bioremediation processes, knowledge about molecular-genetic, physicochemical, and chemical characteristics of the groundwater as well as geological parameters of the site is needed. The aim of this work is, therefore, to develop a user-friendly software allowing assessment of bioremediation processes. The software enables an interpretation of input data, resulting in evaluation of potential for natural bioremediation at the contaminated sites. Suitability of conditions for bioremediation is simultaneously evaluated in this software. Moreover, data from one sampling round are only used to ensure widespread user availability, the program was created in Microsoft Excel. Actual data from the Novy Bydзov site were used to verify and demonstrate program’s functionality in this work.

TU263 REMEDIATION OF AQUATIC ECOSYSTEMS: ADSORPTION OF PHOSPHORUS BY SAWDUST
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 concern with the dephosphation deposits, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorous 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 microbial 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 jars’ water column. Emerging contaminants and adsorbed phosphorus (P) were determined by classical methods. Results: 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 indicative 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 g−1 sawdust). The adsorption of alachlor and caffeine was not observed in sawdust. The concentrations of carbamazepine, dichloran, paracetamol, ibuprofen, naproxen, propranolol, triclosan, estradiol and 17-ethinylestradiol are lower than the limit of quantification (LOQ). Conclusion: Sawdust is considered a biosorbent, of easy access and low cost, to use in the remediation of eutrophic environments. The possibility of phosphorus recovery is important to ensure water and global food security. Acknowledgments: FAPESP (2016/00490-6)
Formation potential of trifluoroacetate and its estimation by means of the TOP assay

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Trifluoroacetic acid is the perfluorinated carboxylic acid with the shortest-possible chain length and thus a small, persistent molecule. Due to its high acidity (pKₐ < 0.25) it occurs in its anionic form (trifluoroacetate, 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 high performance liquid chromatography coupled to tandem mass spectrometric detection (IC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet, fluopicolide, flufenpyram, flurtamone and tembotrione; pharmaceuticals: fluoxetine and sitaglipin; industry chemicals: 4:2 FTSA and 6:2 FTSA) led to substance-specific molar yields between 7.1% (6:2 FTSA) and 96% (sitaglipin). It is known from previous studies that TFA can be formed during wastewater treatment. 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

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The substance 1,2,4-triazol is a known metabolite of several fungicidal active substances used in plant protection products. Modelled groundwater concentrations of pesticides and metabolites 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 several other routes. Therefore the formation inhibitor 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

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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. Using the method described in this paper, 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 triacylglycerides 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.

Persistence & Biodegradation Assessment (P)

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Persistence in dissolved phase

When considering the large number of chemicals potentially present in the environment, the scientific community seeks to establish a pertinent list of priority compounds. Assessing the persistence of chemicals such as pharmaceuticals or polar pesticides represent a need in order to realize a better prioritization of compounds of concern. Persistence in dissolved phase is widely dependent on intrinsic properties of compounds but also on environmental conditions such as temperature, salinity, or presence of microorganisms. Estuaries are characterized by gradient and high variability of salinity and suspended solids (SS). The environmental risk assessment may need to be adapted to dynamic conditions such as those prevailing in transitional areas. This study focuses on the persistence of polar pesticides and pharmaceuticals into turbidity maximum zone of the macrotidal Seine estuary. Laboratory batch experiments simulating mixing conditions of the discharge of wastewater into estuarine water were performed. The influence of SS concentration, salinity and abiotic control was assessed on a selection of 60 polar pesticides and 51 pharmaceuticals. In order to compare relative compound persistence in dissolved phase, a persistence index based on the half-lives of the compounds was calculated. Briefly, marks depend on half-life values of each condition, and the average mark gives the persistence index. Risk quotients are calculated with measured environmental concentrations of each compound in the Seine estuary. Of the 111 monitored compounds, 33 were quantified at the initial time. Only 3 exhibited a persistent behavior (e.g. atrazine, guanylurea, which is considered as persistent in fresh water). These preliminary results show that microbial communities can adapt to degrade a molecule that was initially persistent. These results are a first step to understand adaption mechanisms and their implication for the persistence of organic compounds of emerging concern. This project aims at correlating microbial adaptation and biodegradation performance in time. The ultimate aim is to design more robust and realistic RBTs used adapted inocula.

Prioritization of organic compounds based on their persistence in dissolved phase

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Preparation of biodegradation and contamination datasets

When preparing datasets for biodegradation and contamination assessment, the selection of chemicals or compounds of concern is of utmost importance. This project aims at correlating microbial adaptation and biodegradation performance in time. The ultimate aim is to design more robust and realistic RBTs used adapted inocula.
index and measured concentration in the Seine estuary were used together and allowed a categorization of compounds into 4 levels of environmental concern. Moreover, non-targeted analysis highlighted the formation of 794 compounds during 21 days of incubation, in high concentration level of SS condition. In order to improve risk assessment, formation of transformation products should have to be considered and included in prioritization schemes.

TU269  
OECO 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers  
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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, regarding 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 settings chosen for the test (i.e. sediment-water ratio, aerobic-anoxicarobic 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 Grindelach, 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<0.001) 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 is more relevant than in the water compartment, as 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  
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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 provide the water compartmental QSAR models were only 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 biodegradation 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 (Pₜₐ₅).

TU271  
Persistence assessment of pesticides in Denmark  
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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 persistence evaluation is based on an assessment of available reliable half-lives from both laboratory and field studies. All half-lives should be normalized 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 constitue 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 persistence.

TU272
Influence of Winter Conditions on Fungicide Persistence in North American Golf Course Turfgrass  
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Fungicides are routinely applied to golf course turfgrass prior to winter to temperate climates around the world to protect the plants against psychrophilic plant pathogens. The persistence of these fungicides in the environment varies depending on the winter 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. For this purpose, we incubated soil from both fungicides with a chromatography-mass spectrometry, and a bioassay was conducted in a controlled environment chamber using the psychrophilic plant pathogenic fungus Microdochium nivale to determine the date when disease protection was lost. Fungicides were applied once on 20 Nov 2015 and again on 5 Dec 2016 and 10-cm diameter turfgrass cores were collected biweekly from the experimental area for one 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  
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The significant increase in plastics productions caused waste management problems which is particularly relevant for polystyrene plastic as the most dominant packaging material. Therefore, investigations of new biodegradable polymers are increasing. Graft copolymerization is important technique for physical and chemical modification of polymers. The microbial levan is biocompatible, biodegradable, renewable and eco-friendly fructose based polymer. It can be produced from sucrose by wide range of microorganisms levan producing microorganisms. In the present study graft copolymer with microbial levan and polystyrene was synthesized, characterized and its biodegradable potential was investigated.
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 signals attributed to both monomers and O2 consumption in copolymer sample (705.0 L) compared to control (350.9 L) and polystyrene (499.5 L) after 673 h. The formation of levan and polystyrene 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.

T2/74

Aerobic degradation of styrenated phenol in soil: influence of the temperature and of the characteristics of the soils

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The persistence of chemicals is assessed through their kinetics 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 sometimes complex. Degradation of 2,4-D and 2,6-D in soil was studied without delimitation, despite a standardization 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 soils is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

T2/75

Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests

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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 toluenediamine (TDA) substances. Degradation (14C) 2,4- and 2,6-TDA was studied using both the OECD Guideline Nos. 301B and 308, wherein their disappearance, formation of degradation products, and evolution of CO2 were measured in period of 28 days. The 301B test used an inoculum collected from a domestic sewage treatment plant, while the 308 test used water/sediment collected from two diverse tributaries of the Rhine River. Disappearance of TDAs in the RBT followed parent-first-order kinetics, and half-lives for the 2,4- and 2,6-TDA were approximately 43 and 17 d, respectively. For 2,4-TDA, evolution of 14CO2 was equivalent to 4% and 7% of the applied radioactivity (AR) after 28 and 63 d, respectively, while that from 2,6-TDA was 12 and 24% of AR, respectively. The TDAs were removed by >90% in the RBT, with the balance of AR associated with the biosolids. In the 308 test, the TDAs were rapidly transformed from their fully-dissolved state in water to a non-extractable residue (NER) in the sediments beneath. After the first 11 d, radioactivity in the river water reduced to <10% of AR, several transiently-formed degradation products were detected (tentatively identified by high resolution LC-MS), and NER accounted for ≥79% of AR for both TDAs in both river systems. Disappearance of TDAs was fitted to a dual first-order-in-parallel kinetic model, with 50% depletion times (DT50) of approximately 0.4 – 1.0 d and 0.7 – 1.2 d determined for the 2,4- and 2,6-isomers, respectively, in both river systems. Yields of 14CO2 were ≤10.6% of AR for the 2,4-isomer and ≤8.3% of AR for the 2,4-isomer in both river systems after 100 d. In all cases, <1.5% of AR could be freed from the sediment using vigorous solvent extractions. The results of both test types show that the TDAs are not persistent in the sediment, and are transformed by concurrent biodegradation and abiotic reactions. While the RBT gave a reasonably conservative approximation of the DT50 times and 14CO2 yields in aerobic surface water/sediment systems, it did not give a realistic representation of the fate mechanisms which result in formation of NER with natural organic matter in the environment.

T2/76

Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in Sediment cores from an e-Waste Site, South China

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Biodegradation of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) is an important transformation and detoxification route in the environment. To better understand the in-situ microbial degradation of PCB and PBDE in anaerobic sediment, three sediment cores from an e-waste dismantling site, South China, were sampled (named #1, #2, and #3, respectively). Positive factorialization 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 PBDE (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 chemical mixtures are different in each PCB and PBDE input and dehalogenation takes place in the sediment cores, especially for PBDEs. 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) were 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) and PBDEs (with p-values of 0.01, 0.01, 0.10, 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 debrumination processes.

T2/77

Transformation and degradation mechanisms of flame retardant triphenyl phosphate in aquatic environment

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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 OPFRs in the 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 analysed using liquid chromatography-tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray high-resolution 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 (DHP), product of phase I reaction, was identified for biotransformation products both biota and medium. Among phase II reaction, sulfonyl triphenyl phosphate was verified; intermediate metabolites were not significantly detected due to brief retention times. Parent compound (TPHP) and hydrolysis products (DHP) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DHP; as TPHP showed decreased, degradation product (DHP) 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.

T2/78

Photolytic and biological degradation of silicon organic compounds

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This study provides new data on the degradability and persistence of a selected group of organosilicon compounds, which are newly synthesized and used as a starting point of industrial chemicals, which are frequently produced in high amounts. They are widely used in industry, personal care products and agriculture. In general, silicones occur ubiquitous in the environment in different concentrations (e.g. in water from ng to mg per L). Since these polysiloxanes are only cleavable by chemicals, potential substitutes, which are better degradable in the environment, are urgently needed. Therefore, we synthesized newly synthesised homogenous group of silicon organic compounds (p-MeOCH3SiMe2, o-MeOCH3SiMe2, p-MeOCH3SiMe2, p-MeNCiH3SiMe2, o-MeNCiH3SiMe2) with higher water solubility was investigated to provide new and reliable data on
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. In order to study the effects of sunlight degradation, the compounded was kept at certain degree. After 6 hours, 99 % of the substances p-MeNC6H4SiMe3 was primary 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 tests were in line with the literature and 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

TU280 Applying high-resolution mass spectrometry to evaluate chemical persistence in un-spiked natural waters

TU281 A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals

Development of a multi-sensors device to assess the biodegradation of chemicals

A Ultimately Transformed Organic Carbon (UTOC) concept is presented to evaluate the biodegradability of complex chemicals in an aquatic system. The UTOC approach is based on the measurement of different parameters such as the concentration of the initial raw material converted to an inert product by the action of biological materials. It appears that coupling ecotoxicological tests with 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 O₂, CO₂, 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.

**TU263 Investigations on key parameters of an innovative biodegradation test based on cell proliferation**

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Screening and OECD 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 CO₂ 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 at more environmentally 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 cytometric 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 CO₂; and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

**TU284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances**

T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tengrymsia, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; O. 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 fail the test 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-methylpentracontane, 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. 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-trimethylhexanoic acid, is insoluble in water and tends to stay on the water surface and volatilize. An initial ready 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.

**TU285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants**

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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. Carbamazepine, diclofenac and metformin are commonly detected pharmaceuticals in wastewater, while 4-chloroaniline and N-methylpiperazaine 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 compounds using this glassware. We sealed bottles with an 86 well plate, and incubations were used for the incubation and elimination is measured by following the CO₂ 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.

**TU286 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 Guidance on OECD standard OECD 301) adaptation is 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 our key objectives was to collect and provide a detailed raw data about the adaptation process of the inocula. 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.

**TU287 Use of Chemical Analysis to Enhance Interpretation of Biodegradability 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 exploration and production of oil and gas offshore in the North Sea. Chemical suppliers must submit a Harmonised Offshore Chemical Notification Format (HOCNF) to the implementing OSPAR member state authority to certify 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 guidelines for biodegradation and different test results are often 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 biodegradability tests can be improved and interpreted will be provided. REFERENCES 1) ECETOC Workshop Report No.34 – Improvement of the OECD 306 Screening Test. Published September 2017. Available online via: http://www.ecetoc.org/publication/workshop-report-no-34-improvement-oecd-306-screening-test/ 2) Hughes, C., Whale, G., Mead, C. (2015). Investigation into the
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. 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, bioavailability 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, these results in major enhancements also address 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 standardisation 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 intra-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 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 to 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 intra-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 TPT congeners.

TU290
POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
s, katsak, 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, n-HCH congeners (4.48 ng/L) were detected within 10%. 95% DDE (31.2 ng/g dw) concentrations are higher than those observed by 5 times or more. Of the tested 8 PCBs, polychlorinated biphenyl (PCB) congener, only 6 PCBs were detected. M = 8780 h) suggested previously. Different halides could be possible, either if the rate of actual photoreductive-dechlorination process is different for congeners other than the two congeners which were experimentally determined previously or due to occurrence of hydroxylation reactions in snow that have been shown to be responsible for a more efficient degradation of lighter congeners (PCB-7). It is also possible that the higher intensity of solar radiation in Antarctica is driving a faster degradation reaction, albeit for the lighter congeners only. Overall, PCB congener distribution in some samples can be explained by a direct contribution from sources, while for others the biodegradation step is responsible for the remaining observations. More studies are required to identify and constrain the PCB sources in the Schirmacher Hills, and PCB congener degradation kinetics in snow.

TU291
Degradation of crop protection products in Brazilian soils
N. Badrin, 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
Bisphenol A (BPA) is a compound widely used in different commercial products (i.e., di- and mono-phenyltin) using gas chromatography mass-spectrometry. We found that the accumulation tendency of TPT was highly tissue-dependent. Highest concentrations of TPT were consistently found in liver, whereas scales and swim bladders contained the least amount of TPT. Mass-balance model showed that muscles (dorsal and ventral) generally contributed to 50% of the total body burden of TPT in these fishes on a wet-weight basis. We hypothesized that TPT concentration of the whole organism could be predicted using its concentration in dorsal muscles (p < 0.05, r² = 0.973), which indicated that dorsal muscles can actually represent the contamination in the whole organism on dry-weight basis. Our findings on profiling the distribution pattern of TPT compounds would help identify potential TPT-induced organ-specific toxic effects in fishes, and the potential of bio-magnification of TPT in marine food webs.
future works, the activity of the enzymes like Laccases and Manganese-Dependent Peroxidase should be taken into consideration and evaluated, as well as to compare the degradation with an abiotic system containing the BPA pattern – in order to evaluate its persistence in the culture medium.

**TI/203**

**Soil dissipation of paraffin oils: Improvement of the microbial degradation and impact on soil dissipation.**

P. Adrian, A. Barret, CEHTRA SAS; G. Destrycker, CEHTRA, P. Lemaire, TOTAL Fluids

The study was conducted according to OECD 307 and the active substance applied onto soils according to Good Agricultural Practices in EU. Four soils were freshly collected from sites in Germany and handled per the International Standards for Soil Quality and the Organisation Standard ISO/DIS 10381-6 Part 6 and Good Laboratory Practices. Following incubation the soil samples are extracted and further analysed by GC/MS i.e. monitoring of one ion (m/z) for the internal standard (66 m/z) and one ion for the test substance (57 m/z). Satisfactory method performance was achieved at each degradation interval, as verified by recovery efficiency testing. The test substance, Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids, dissipated to below 50% of the original concentration over a 17-day period after the initial treatment (DAT) in all four soils evaluated in the study. From 17 DAT through 122 DAT the concentration of Paraffin Oil CAS (72623-86-0) produced by TOTAL Fluids, increased to 80-90% dissipated in all four soils evaluated. From 122 DAT through 300 DAT there was no substantial dissipation of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids. Existing in any of four soils occurring. Two treated soil samples were then treated with dextrose, ammonium nitrate and monopotassium phosphate in order to improve the remaining bioactivity. The remaining residues of the applied substance was then followed for two weeks. The results showed that for one soil a complete dissipation of the remaining residues occurred although in these time of incubation a plateau was observed. As the tested methodology is therefore proposed to demonstrate for certain chemicals that the degradation is of biological origin and to integrate these results in the proposed end points.

**TI/250**

**Leafing of PAHs from Coal Mining Heap Samples from the Saarland**

T. Schiedek, Applied Geosciences / Applied Geoscience

After 250 years coal mining stopped 2012 in the Saarland, Germany. Ca. 80 mining heap occurs. Heaps contain a significant amount of natural coal, well known as a source of polycyclic aromatic hydrocarbons (PAHs). PAHs are pollutants with high persistence, toxic impact on organisms. This study aims at quantifying the leaching of PAHs which could exist under most real conditions leached from heap sediments. Samples (10 cm) from heaps of Duhamel, Göttelborn, Lydia, Reden, Viktoria and 2 coal samples, were extracted and used in batch experiments. Leaching experiments with an automatic extraction unit (Dionex300) were executed, using acetone (potential leaching) and water at different temperatures (40°C and 80°C, “real” leaching). Additionally, batch experiments with water were executed by ITOH. Existing in any of four soils occurring (10 days). The 16 EPA-PAHs and four additional PAHs (1-methyl-naphthalene, 2-methyl-naphthalene, benzo[e]pyrene and perylene) were analysed by gas chromatography with mass detection. Additionally total organic carbon (TOC) and physico-chemical parameters (pH and TDS) were analysed. The heap samples contained a potential concentration in the range of 0.01 - 36 mg/kg. The experiment showed values of 36 mg/kg was found in the heap Lydia (most abandoned PAH was naphthalene). In general, light PAHs (mass lower 202 AMU) were found in concentrations up to 40 times higher than heavy PAHs. Coal samples showed 4 times higher PAH concentrations (most abandoned light PAHs) than sediment samples. However, the water extractions showed only light PAHs. The batch experiments (3 samples per heap, 1 coal) showed only light PAHs in the water phase (concentrations from 0.1 – 0.5 μg/L), with 2-methyl-naphthalene (0.5 μg/L) in the coal sample. The highest concentration of total PAHs of a heap was found at Lydia, ca. 6 times higher than the lowest concentration found in the heap Lydia. Potential light PAH concentration in sediments (acetone extraction) were ca. 3 orders of magnitude higher than water extractions at 40°C and 80°C or in batch experiments. The extract at 80°C showed 20 times higher concentrations than at 40°C for the lighter PAHs. TOC content was found to be above 60% in coal samples (90% OC). Sediment showed TOC values in the range of 2% - 8%. Light PAHs from heaps have been found to be mobile, but maybe immediately sorbed by natural TOC. However, dust emissions may pose a potential risk from heaps.

**When ecotoxicology meets trophic ecology (P)**

**TI/295**

**Will detoxification processes drive marine mammals still be effective in the future?**

P. Mendez, Observatorio Pelagis; J. Spitz, Observatorio Pelagis Université de La Rochelle/CNRS; F. Caurnt, Université de La Rochelle / LIENNS

In marine mammals, food is the main route of entry for contaminants. Their concentrations can largely vary among prey species, for that reason differences in bioaccumulation will arise from differences in predator diet. Among all the contaminant that marine organisms faced, metallic trace elements (MTE) are natural substances that have been present on the earth since its formation. MTE can be divided in essential and non-essential in function of their biological role in the organisms. Low concentrations of essential elements can lead to deficiency effects. On the contrary, excess of non-essential elements (i.e. cadmium (Cd), mercury (Hg) and lead (Pb)) can induce toxic effects. However, their long-term presence in to the environment has allowed to marine mammals and other marine organisms to developed mechanisms to mitigate the potential toxic effects of these non-essential elements. The best known detoxification process is the demethylation of Methyl-Hg by Selenium (Se) forming granules of trimethane (Hg3Se2) in their liver. Today, anthropogenic activities induced a continuous increase of Hg concentrations in the environment, altering their availability as well as their uptake by marine 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 essential 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 of high concentrations can occur because of its long-range-tang 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.

**TI/296**

**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, the presence of common biofilm is often considered in 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 also accumulate mercury (Hg), a pollutant of high concern because of its long-range-tang different 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 at 20±8°C to 0.2 lg/L and 2.0 lg/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.

**TI/298**

**Multiple stressor effects on resource quality for consumers: a case study with photobiophotophic biofilm exposed to phosphorus and ionic silver**

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Autochthonic biofilms are fundamental biological compartments of many aquatic ecosystems, representing notably a major resource for many invertebrate 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 (C:N:P ratios) 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 producer species, would reduce the
biological quality of biofilms for their consumers. The quality of biofilms for consumers was assessed for a common crustacean species, Gammarus 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 C:P biofilms, whatever the level of silver contamination. Gammarids 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 gammarids growth, while biofilm fatty acid contents were unrelated to this parameter. This study underlines the large indirect consequences stressors could play on basic 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. Bilhour, Université de Lorraine CNRS UMR 7360; A. Cébron, LIEC CNRS UMR Université de Lorraine; S. Coq, CEFE CNRS, Montpellier; V. Felten, LIEC / LIEC UMR Université de Lorraine; J. Nahmani, LIEC 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 mechanism intoxication process, we compared in this paper the leaf litter decomposition by the diplopond Glomeris marginata, used as a model detritivore. Our results indicated an impact of soil contamination on leaf litter chemical composition, leading in turn to significant impacts on diplopond physiology (in particular the increasing amount of detritus from each environment exposed to contaminated litters). However, pollution mediated changes in leaf litter chemistry had no significant impacts on microbial litter colonization (bacteria/fungi ratio) and litter consumption by detritivore, confirming the high resilience of litter decomposition process to soil metal contamination.


Organic matter decomposition (tea bag index) and feeding activity of mesofauna (Bait Lamina) were studied in an abandoned mine tailings area. Six environments were studied: 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 >≈4 m high and shrubs and herbs under the canopy (DP+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). The presence of soil fauna was demonstrated shortly after admission to the vegetation. Defecated litter samples were spiked with surrogates and homogenized in a mixture of methanol and water (2:1/v/v) and cleaned up by solid supported liquid extraction with a diatomaceous earth column (Gedulin et al., 2014, DOI: 10.1016/j.scitotenv.2014.07.09008-9697). Quantification of the analytes was performed by LC-ESI-MS/MS with a calibration from 0.1 to 100 ng/ml (r² > 0.99) and a signal to noise ratios > 6.1 for the lowest concentration level. The neonicotinoids imidacloprid with the metabolites 5'-OH-imidacloprid and 5'-OH-imidacloprid-ol, thiamethoxam and clothianidin with TZMU and TZNQ were not found in the predators although expected especially in case of insect-consuming species such as little owl (Athene noctua). Similarly, we detected no residues of the phenylpyrazole fipronil, which has a higher bioaccumulation potential and the metabolites F-epoxide, F-sulfide and F-carboxamide. One to four substances of the rodenticides chloropocarbamate, difenacoum, bromadiolone, flobrofacoum, flocoumanate and difethialone were found in 30% of the liver samples, originated from 14 different districts. Bromofacoum was detected in more than 70% of these samples. No sample contained coumatetralyl and warfarin. Residues occurred more often in avian predators than in rodents than in generalists; e.g. 44% of the 26 liver samples from common buzzards (Buteo buteo) contained residues. The portion was with 80% even higher for red kite (Milvus milvus) but only 5 samples of this species were examined. A residues distribution pattern will be presented but more samples are necessary for final statements.

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. Redo, Dept. of Psychiatry, University of Calgary / Ecosystem and Public Health; M. Durakal, National Veterinary Research Institute / Department of pharmacology and toxicology; R. Mates, IREC-CSIIC- 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 constitute an environmental and health risk. Since Pb is a particularly toxic metal for both animals and people, there is a need to explore how to prevent or reduce exposure. Therefore, 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 in vitro 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 one served as control. Then, the Pb exposure was evaluated in blood, milk and feces, and the phytosiderophores (PHA)-skin test was used to evaluate T-cell-mediated immunocompetence. 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 those of the control group. In this group, Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 µg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animal. These findings could open the way to the development of programs which would allow the use of Pb flock in livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced Pb exposure through milk consumption by the local human population.


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 predation takes place. In this paper, the levels of non-supplemented target species. The analysis focused on anticoagulant rodenticides, neonicotinoids 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 showed signs of intoxication shortly after admission to the veterinarian. Defecated liver samples were spiked with surrogates and homogenized in a mixture of methanol and water (2:1/v/v) and cleaned up by solid supported liquid extraction with a diatomaceous earth column (Gedulin et al., 2014, DOI: 10.1016/j.scitotenv.2014.07.09008-9697). Quantification of the analytes was performed by LC-ESI-MS/MS with a calibration from 0.1 to 100 ng/ml (r² > 0.99) and a signal to noise ratios > 6.1 for the lowest concentration level. The neonicotinoids imidacloprid with the metabolites 5-OH-IMD and IMD-olefine, thiamethoxam and clothianidin with TZMU and TZNQ were not found in the predators although expected especially in case of insect-consuming species such as little owl (Athene noctua). Similarly, we detected no residues of the phenylpyrazole fipronil, which has a higher bioaccumulation potential and the metabolites F-epoxide, F-sulfide and F-carboxamide. One to four substances of the rodenticides chloropocarbamate, difenacoum, bromadiolone, flobrofacoum, flocoumanate and difethialone were found in 30% of the liver samples, originated from 14 different districts. Bromofacoum was detected in more than 70% of these samples. No sample contained coumatetralyl and warfarin. Residues occurred more often in avian predators than in rodents than in generalists; e.g. 44% of the 26 liver samples from common buzzards (Buteo buteo) contained residues. The portion was with 80% even higher for red kite (Milvus milvus) but only 5 samples of this species were examined. A residues distribution pattern will be presented but more samples are necessary for final statements.

TU303 Trophic Magnification of POPs including PFCs within a terrestrial food-web of an avian top predator, the Cooper’s Hawk (Accipiter cooperii)
highlighting the importance of rice concentrations in zooplankton from the more freshwater influenced sites, influencing forces for the zooplankton community, and zooplankton from the more freshwater abundances were higher in freshwater than marine dominated systems and system. DOC, TOC, total Hg and silicate concentrations reflected physical mixing occasions in 2015/2016. Physical dynamics along a river OM and Hg dynamics at the freshwater as well as bioaccumulation of contaminants, there is considerably less known contaminants such as mercury (Hg). While several studies exist on effects of and marine ecosystems. The presence of tDOM in several studies in boreal areas. This leads to the question if high riverine input of In Institute for Water Research Kaste, NIVA Norwegian Institute for Water Research; A. Poste, Norwegian Hessen, University of Oslo / Department of Biosciences, University of Oslo / Department of Biosciences; T. Andersen, D.O. S. Schultze Seasonal dynamics of zooplankton community, trophodynamics and Hg across a gradient from a DOM rich river to a marine system S. Schulze, University of Oslo; A. Ruus, NIVA / NIVA; K. Borgia, Department of Biosciences, University of Oslo / Department of Biosciences; T. Andersen, D.O. Hessen, University of Oslo / Department of Biosciences; H. Veiteberg Braaten, O. Kaste, NIVA Norwegian Institute for Water Research; A. Poste, Norwegian Institute for Water Research Recent increases in terrestrially derived dissolved organic matter (DOM) in freshwater (“browning”) and marine systems (“coastal darkening”) have been noted in several studies in boreal areas. This leads to the question if high riverine input of terrestrial derived material will affect the food web dynamics of recipient brackish and marine ecosystems. The presence of IDOM may affect light attenuation, primary production, and zooplankton composition. Trophic and biotic factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. Overall, terrestrial TMF values for POPs were determined to be significantly higher than TMF values determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems. C. Cuéllar, UPRM; C. Acosta, UPRM; M. Ferrer, UPRM; Y. López, UPRM; C. Fernández, UPRM; L. Méndez, UPRM; E. Guzmán, UPRM; R. Elías, UPRM; J. Berrocoso, UPRM; S. Flamenco, UPRM; G. Baez, UPRM; J. López, UPRM; R. Martínez, UPRM; G. Ruiz, UPRM; J. Mendez, UPRM; A. Jiménez, UPRM; and A. Cuéllar, UPRM. This is part of a larger study in North Spain that aims to develop biota quality 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 produced, versus trophic position. Trophic and biotic factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. 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Trophic and biotic factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. Overall, terrestrial TMF values for POPs were determined to be significantly higher than TMF values determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems. C. Cuéllar, UPRM; C. Acosta, UPRM; M. Ferrer, UPRM; Y. López, UPRM; C. Fernández, UPRM; L. Méndez, UPRM; R. Elías, UPRM; J. Berrocoso, UPRM; S. Flamenco, UPRM; G. Baez, UPRM; J. López, UPRM; R. Martínez, UPRM; G. Ruiz, UPRM; J. Mendez, UPRM; A. Jiménez, UPRM; and A. Cuéllar, UPRM. 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Overall, terrestrial TMF values for POPs were determined to be significantly higher than TMF values determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.
standards of several heavy metals, to contribute to water quality management to take forward the conservation of macroinvertebrate communities. The specific objectives of the study were: first, to model the relationships between 4 macroinvertebrate community metrics (number of families and abundance of EPT and PT), one multimetric (METI) and a predictive model (NORTI), using the Cu and Hg body residues as predictor variables; second, to assess Cu and Hg toxicity to benthic communities through the estimation of effective body residues (ER); and third, to investigate the taxa-specific differences in metal ERs in relation to their feeding styles. The ERs were estimated for each taxon and metal from the best non-linear models, selected using Akaike’s Information Criteria, and compared with the 90th percentiles (P90) of the data distribution in the reference sites of the study area, considered an approach to threshold (no-effect) concentration levels. The models were fitted for each taxon but only in few instances for Hg. Results showed that Cu-ERs and Cu-ERs in 4 taxa (Baeotidae, Hydropodidae, Ephemeriellidae and Microdrilii oligochaetae) were usually less than 2 times above the P90, calculated for the same taxa. These ERs in other 3 taxa (Heptageniidae, Ephemeriidae, Rhyacophilidae) were mostly within the range of 2.1 to 5.0 times the P90. The largest ratios were found in ERs for Lumbricidae and Perlidae, which reached 12 times the P90 values. In the case of Hg, the predator taxa (Rhyacophilidae and Perlidae) and some of their potential preys, e.g. mayflies and simulids, showed ERs that were typically within the range of 1 to 3 times their respective P90s.

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 Edutainment 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 ingested, 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 had a significant decrease after each feeding treatment. These findings suggest a contaminant transfer from crustacean nauplii to ephyrae able to induce sublethal effects.

TU309
Tussilar chronic injuries in Crassostrea virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.

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Heavy metals are known to accumulate 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. Once in the environment, they can in incorporate contaminants by absorption or adsorption. If these algae accumulate contaminants, such as metals, the organisms that feed on them like the oyster Crassostrea virginica can in turn incorporate them through filtration, which may have negative consequences. The objective of this work was to evaluate the effects derived from the trophic transfer of copper and cadmium from Chlorella sp. to C. virginica. Microalgae were used for 110 h at a sublethal dose of copper and cadmium (0.1 mg/L). A concentration of 30 X 10^6 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 inflammation and injuries that compromise the body’s physiological processes such as feeding and breathing. These damages were evident after the first 96 h of exposure to the contaminated food. However, lesions were not observed in worms with cadmium exposure, a non-essential metal, in more than 50% of organisms could be observed on day 10 and those associated with more than 50% animals in co-occurrence were deferred to day 15. The presence of Chlorella sp. in the digestive tract made possible to associate the injuries within 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. Braunbeck, 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 Artemia spec. nauplii and zebrasfish (Danio rerio). Therefore, cryogenically ground microplastic particles, made of polystyrene (}

TU311
Toxicokinetics links predator-prey dynamics to assess zero-valent iron nanoparticles bioaccumulation in a Caenohabditis elegans-Escherichia coli ecosystem

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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 Caenohabditis elegans (C. elegans)-Escherichia coli (E. coli) ÖPSecosystem. METHODS: The bioinorganic parameters, uptake and depuration rate constants of bacteria and NPs were obtained from toxicokinetic experiments and related published literature. Biomass dynamics of bacteria and worms were estimated by employing the Lotka-Volterra model. Dynamic of FeNPs accumulations, bioconcentration 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 Fe/NPs exposure. We also observed that internal concentrations of Fe/NPs 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 Fe/NPs 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 toxicokinetic results confirms the hypothesis that the consumer-resource dynamics are effectively associated with Fe/NPs 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/YAS) FOR THE SCREENING OF ENDOCRINE DISRUPTION IN SURFACE WATERS OF WALLONIA (BELGIUM)

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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, phthalates, chlorophenols,
perfluorates, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic activity and androgenic activity 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 39 samples and investigated antagonist activities were detected in 42 % and 55 % of the samples, respectively. When the estrogenic activity is 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 estrogen 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 recommendations 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 pollution of tributaries to the Alqueva Reservoir (Southern Portugal)

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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, Álamos, 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) hormone-like substances using four different end-points, using biotesters indicating different trophic levels (Vibrio fisheri, 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 of biological life, with regard to nutrient and oxygenation conditions. Concentrations of the detected substances were low, being benzotriazole the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of benzotriazol 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 allowed identifying 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.

TUI314
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. Leverett, 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 conventional WFD (OC) approaches 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 waters 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 surrogates), and in vitro or bacterial assays for endpoints based on endocrine disruption (oestrogen, androgen and thyroid), genotoxicity, oxidative stress, and metabolism of polyaromatic hydrocarbons (PAHs). Commonly used whole-organism assays (e.g. acute test, algae growth inhibition or multi-effect battery assay) were not included, since they had already proven well tested with no detailed evaluation required. However, EBTs 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 reviews and 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.

TU315
Innovative ecotoxicological monitoring strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD)

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The Water Framework Directive (WFD, 2000/60/EC) regulates the European water bodies and their use with the objective of achieving a 'good status' in terms of chemical quality (no toxic chemical exceedances). This is based on the existing aquatic life protection and ecological quality reference values and the recognition that aquatic life tests are the most pertinent methods for identifying water quality issues. The WFD also calls for the development of zebrafish (Danio rerio) embryo as a short term toxicity test to be used alongside existing aquatic life tests in the water monitoring strategy at a regional level. In a meeting the next step, by making a literature review on the priority and emerging substances widespread in the aquatic environment, to investigate their effects on the development of zebrafish (Danio rerio) embryos. Then, a few toxic substances that are relevant for our goals have been selected and analysed through the fish embryo acute toxicity test (FET) and other assays; particular attention has been given to the sub-lethal effects. Afterwards, environmental samples from different aquatic systems in Italy will be analysed to detect the chemicals present in these sites as well as their toxic effects. In order to reach a better comprehension of the effects of substances on the environment and how to derive conclusions from different trophic levels (bacteria, algae, daphnids) will also be performed. The study will ultimately aim to provide recommendations for the implementation and the update of the monitoring strategies of the WFD, as well as to enhance the current EU activity on Effect-Based Methods.

TU316
Chemical and Ecotoxicological Monitoring of a marine coastal area in the Central Italy

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A monitoring campaign in Central Italy with the aim to characterize the chemical quality status of the coastal marine area in order to detect the possible impact of the emissions of a Coal fired power station and other sources of pollution in proximity of the city of Civitavecchia. The sampling has been carried out in two different seasons of the year along the marine coastal area and in a transitional surface waterbody (Saline di Tarquinia). The analysis has been performed on the water samples with the first 20 principal components of the sediments. The chemical substances analyzed included several priority substances of the WFD (water framework directive) and other chemical substances: Metals, Dioxins, PCB, PAH, Naphtalene. The Ecotoxicological assays have been performed with the use of algae (Phaeodactylum tricornutum) and crustaceans (Artemia franciscana and Tigriopus fulvus). The results have showed a diffuse light exceedance of the sediment and water quality standards of the Italian legislation for some metals (e.g. arsenic, lead, chromium, mercury) and naphtalene; the data of the column were in general below the environmental quality standards, but Uranium has been detected in surface water samples at concentrations above the available PNEC.
(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 might be present in concentrations to achieve the good quality status required by the water framework directive. The presence of Uranium in the marine coastal area should be further investigated to understand the possible role of the coal fired power station.

TU317

USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSOME ASSAY FOR THE IDENTIFICATION OF MUTAGENIC PROFILES IN WATER SAMPLES AND SUSPENDED PARTICULATE MATTER

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The Salmonella/microsome mutagenicity assay uses the genetically modified Salmonella enterica serovar Typhimurium bacterium, and the exploration of these different genetic characteristics allows the detection of various classes of mutagenic compounds. 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 microsuspension assay with and without metabolic activation (S9). The strains used were: 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. In this way a variety of different classes of compounds could be detected 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 more difficult to identify. 

ACKNOWLEDGMENTS

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TU318

NTA meets EDA: A practical example

J. Jünke, V. Hinnenkamp, P. Balsaa, A. Simon, IWW Rheinisch-Westfälisches IndustrieKalke GmbH; T. C. Schmidt, University of Duisburg-Essen Organic micropollutants play an important role in the assessment of water bodies that are used for drinking water production. On one hand, micro pollutants pass through the wastewater system in sewage treatment plants and subsequently in surface water. On the other hand, there are direct discharges from industry and in addition, there are diffuse sources from agriculture, or from households, buildings and settlements. As major pollution events (i.e. PFC in the river Ruhr) show, water suppliers must always expect to find new critical substances that could pose a potential health risk in drinking water, especially when using surface water. For this reason, it is necessary to initiate a proactive screening of contaminants and their potential effects. Continuous monitoring by high-resolution mass spectrometry also makes it possible to analyze the pollution retrospectively, gain knowledge about temporal dynamics and discharge patterns and thus identify the source of the contamination more frequently. In this context, a fast, robust and routine method for the determination of organic micro pollutants is needed. This project is an approach to analyze organic micro pollutants in water samples with a combination of non-target-analysis (NTA) and effect-directed-analysis (EDA). Samples were taken regionally over the past year in order to obtain an annual progression of the water pollution. A LC-MS QTof system was used to carry out the NTA. Different endpoints were analyzed for the EDA: cytotoxicity (MTT assay), endocrine activities (ER-CALUX and AR-CALUX) as well as genotoxicity (p53-CALUX, umuC assay and Ames assay). Due to the investigation of raw water samples, no significant biological effect of the individual samples was to be expected. The focus of this project was therefore the identification of seasonal expansion trends of the micro pollutant load. The coupling of NTA with a test strategy for toxicological effects forms an innovative approach with potential for preventive product quality assurance of the water supplier.

TU319

Imposex levels in gastropods from the Northern Adriatic Sea (Italy): a proposal of classification according to the Water Framework Directive

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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 gastropods, is the most studied effect of TBT exposure and it is generally recognized as a specific response to organic tin compounds. 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 gastropods collected in the Northern Adriatic Sea and in the Venice Lagoon: Nassarius nitidus (Jeffreys, 1867) and Haliotis tuberculata. For these species, less 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 gastropod 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. Bönlökke Adamsen, P. Gliveson, 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 Directives on water quality set standards (EQS) have been established as legal tools with which to set requirements for number/states. In Sweden, all major surface waters are classified according to the current status of the water designated by authorities in the respective water district. The ecological/status of surface water comprises three different types of quality factors according to the Framework - biological, physical/chemical and hydro-morphological. The latter defines/ecology and biodiversity in the ecosystem, since many aquatic organisms are independent of their ability to migrate during their life cycle. Water power represents a large/affraction (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 Swedish 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 increase the use of hydropower/plants as an alternative to rely on fossil fuels. In the same time water power is the/greats individual cause of physical impacts in lakes and streams. The challenge at this/near stage of Sweden’s national energy strategy is to identify technologies and management practices that promote hydroelectric power with minimal long-term adverse/ecoaglogical impacts. To illustrate the challenges, this paper summarizes work conducted/unver 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 the/Sibro work and it is generally recognized as a specific response to organic tin 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 gastropods, is the most studied effect of TBT exposure and it is generally recognized as a specific response to organic tin compounds. 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 gastropods collected in the Northern Adriatic Sea and in the Venice Lagoon: Nassarius nitidus (Jeffreys, 1867) and Haliotis tuberculata. For these species, less 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 gastropod 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.

TU321

Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish

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

SETAC Europe 28th Annual Meeting Abstract Book
A.O. Ogungbemi, Helmholtz Centre for Environmental Research - UFZ GmbH/ Bioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology

In recent times, zebrafish embryos have gained wide acceptance as an alternative test model for drug development and toxicity testing. In particular, the behavioral activity of a chemical. Even though, effect concentrations vary to some extent among the considered behavioral assays, most of the variability could be explained by the most influential parameters including: exposure time, age at exposure and the type of test model. However, the most influential parameters were found to be exposure time and age at exposure, with exposure time having the greatest impact.

**TU322**

Comparability of Zebrafish Embryo Behavioral Assays: A Need for Standardization and Improved Factors

A.O. Ogungbemi, Helmholtz centre for environmental research - UFZ / Bioanalytical Ecotoxicology; D. Leuthold, Helmholtz Centre for Environmental Research - UFZ GmbH / Bioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology

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**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 / Biological Sciences

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 comparatively 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, *Echinogamarthus marinus* and the freshwater amphipod *Gammarus pulex* were exposed to environmentally relevant concentrations of fluoxetine from 0.001-1 µg/L daily 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 1ng/L and as soon as 1 day compared to controls (P<0.05). Significant differences were observed in thigmotactic and phototactic behaviours both between 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
Invertebrate 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 behaviours 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 behaviour 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 zebrasfish (Danio rerio)
L. Vossen, 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
Pharmaceuticals 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 receptor, is evolutionarily conserved throughout the vertebrates. Behavioural changes have been described for juvenile Eurasian perch (Perca flavescens) and Fathead minnows (Pimephales promelas) at low level contaminations as well as mRNA expression of brain GABAA receptor subunits and mRNA expression of liver enzymes involved in the metabolism of oxazepam. We then correlate these measures of physiological and genetic tolerance with the individual’s behavioural tolerance. The results will shed light on the potential for inter-individual variation in oxazepam tolerance to mitigate the effects of benzodiazepine pollution.

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. J. Johnstone, Norwegian University of Science and Technology; N. Fjellstad, Marine and Freshwater Institute; T. Brodin, Umea University / Department of Ecology and Environmental Science
Benzodiazepines are frequently detected in the environment. 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 biomarker 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. Reinelt, 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 specifically to synapses for the 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 SSRI 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 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 Wassennetzwerk 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; D. 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 and/or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants have effects on multiple levels as well as on synapses. Due to high consumption rates and moderate elimination during wastewater treatment, CIT is one of the most abundant SSRI 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 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 Wassennetzwerk Baden-Württemberg.

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. Allison, 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 disproportionately. 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 zebrafish. To examine the impact of EE2 on mate male 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-exposure on total time males spent associating with the females, when given only visual cues. There was, however, a significant effect on courtship ‘sigmoid’ display with both control and EE2-exposed males spending more time performing sigmoid displays for control females compared to EE2-exposed females. When males were presented with both size-matched females, chemical cues (control and EE2) entered the association zone more frequently, if EE2-exposed female was paired with an EE2-chemical cue. In contrast, sigmoid 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 natural chemical cues influence male sensory ecology in two ways: a gender-specific effect and an environmental chemical communication for exposed wildlife.

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 Nica, University of Milan - Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; V. Lencioni, F. Bellamoli, MUSE-Museo delle Scienze, Dept. of Sci. and Dept. of Anim. Sciences, University of Trento / Department of Chemistry and Biology; V. Di Nica, University of Milan Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; C. Ferrari, 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). 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 behavioural changes. Altered behavioural signals could be induced at sublethal concentrations which are significantly lower than the corresponding LC50. In this study, we compared the sensitivity as mortality and swimming and Daphnia magna, and Diamesa cinerella gr. larvae, a chironomid (Diptera Chironomidae) common in cold freshwater 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 WWTP 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 Systems and Image3DwMTrack) were compared. We found that average speed of D. magna, and D. cinerella gr. larvae was higher in response to undiluted samples. Exposure to serial dilutions of the effluent caused mortality only in D. magna (15% of mortality after 24 hrs at 1:1000 dilutions; 15% and 20% of mortality after 48 hrs at dilutions of 1:100 and 1:1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent induced significant alterations of swimming parameters in both organisms (e.g. the time spent in the swimming activity in the D. magna and the average speed in movement and the cumulative distance travelled in both) at both the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. cinerella 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; S. Beisner, University of Siegen, Institute of Biology / Department of Chemistry and Biology

Daphnia possesses 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 is considered a key component in the freshwater ecosystem. Degradation of phytotoxic substances 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 sunscreen, 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 kairromones 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 counted the number of eggs in the reproductive tracts of the Daphnia magna in the same way as in TU385. A sample of 10 daphnids is taken from each daphnid 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. Roslev, Aalborg University / Biology and Environmental Science Fluoxetine and propanolol are neuroactive human pharmaceuticals that occurs as pollutants in surface waters. The potential impact 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 fluoxetine 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 time and swimming distance appeared to be more responsive behavioral endpoints than swimming velocity and swimming acceleration. The EC50s for fluoxetine and propanolol determined from swimming time and swimming distance were comparable (1 - 2 mg/L). At low sublethal exposure concentrations (µg/L), nonmonotonic 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 fluoxetine 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. Botha, North-West University / School of Biological Science; S. Brand, North-West University; V. Wepener, North-West University - School of Biological Science; P. Roslev, Aalborg University / Biology and Environmental Science 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 1.1 L Tecniplast™ tanks for a period of six hours and videos were analysed using Noldus EthoVision software. The critical swimming speed was performed in a Loolig® swimming tunnel, briefly fish were acclimatized within the chamber for one hour and then at a starting speed of 2 bl/s with a 0.5 bl/s speed interval, fish were swam 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 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 between lights off and on (p=0.110), showing that silver at this 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 open zone was significantly affected. Survival was not affected in any treatment. The authors thank São Paulo Research Foundation (FAPESP 2016/19635-4) 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

Developing methods to determine aquatic invertebrate behavioral 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 significantly dominated by D. magna (EPT 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 thus a narrow exposure window between acute and chronic effects, and thus a narrow exposure window between acute and chronic effects, therefore may be more sensitive e.g. Chironomus, for our experimental settings. Therefore, an agreed method for reproduction endpoints in one standard (Daphnia magna) and two non-standard (EPT: mayfly, caddis) species that are suitable for use in regulatory toxicity testing, integrating the regulatory needs with the practicalities of ecotoxicology testing. [8]

TU340

The effects of sublethal doses of pollutants on crop pest, Spodoptera littoralis

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Pesticides have long been used as the main solution to limit agricultural pests but their widespread use resulted in chronic or diffuse environmental pollutants, 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 positive effects.
hormetic - effects on insects, leading to surges in pest population growth at greater rate than what would have been observed without pesticide application. The present study aimed to examine the effects of sublethal doses of various representative products of large pesticide families used against a major pest insect, the cotton leafworm Spodoptera littoralis, and known to present a residual activity and persistence in the environment. Using an integrated approach from genes to behavior, we focused on the olfactory systems and the sexual or feeding behavior of our crop pest model following application of sublethal doses of deltamethrin, methylin and chlorpyrifos. Whereas sublethal doses of methylin appeared to disrupt the feeding behavior of larvae, we demonstrated a hormetic response of males to sublethal dose of deltamethrin. We completed our study by molecular (qPCR), biochemical (proteomic, AChE activity and metabolic) and electrophysiological approaches in order to decrypt the involved mechanism in pesticide response as well as in the behavioral disruption.

TU341 The effect of copper nanoparticles on olfaction in rainbow trout (Oncorhynchus mykiss)

P. Mohaddes, University of Lethbridge / Department of Biological Sciences; 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 strong affinity for cysteine, an amino acid at least as strong as that of glutamic acid, 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 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 exposure. Continuous exposure. Behavioural responses of rainbow trout to 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, Cu2+ impairs fish olfactory function to a much greater extent than CuNPs.

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

TU342 Perfluoroalkyl acids concentrations in liquid wastes: a survey campaign and implications for waste disposal


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 landfill. 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 representative picture of the main factors and to evaluate the possible 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 PFCOs 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-PFAs. 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 liquors. 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.

TU343 Regenerated Textile raw materials: chemical contamination for LCA A. Franch, 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 ensure proper control of environmental impact. CID (Italian Consortium for Detox Implementation) with the support of local actors (chemical laboratories) made a study concerning chemical contamination of regenerated materials in order to propose a PRSL (Product Restricted Substance List) for regenerated and recycled textile materials. The adoption of a PRSL for regenerated textiles would guarantee the safe re-use of these materials as an alternative to their disposal. This case study takes into account regenerated woolen textiles (high wool content > 70%) derived by post-consumable materials (knitted apparel, apparel made up by carded woven and combed woven), pre-consumable materials (combed and carded woven, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling).

Operational plan involved quantitative and qualitative assessment concerning the extent of the woolen-type raw material used by carded spinning companies in Prato textile district, sampling (more than 100 woolen-type regenerated raw material selected by origin and type and more than 40 cotton-type regenerated materials) and chemical analysis (made by Buzzi Lab) of some priority groups of concerned substances: APEOS (Ethoxylated Alkylphenols), Aromatic amines from azo-colorants, Chlorophenols, PPC (per-fluorinated compounds), Allergenic and Carcinogenic Dyes, Heavy metals from artificial perspiration solution. Results was that about 150 sample were analysed and chemical contamination were found for aromatic amines (16% of total samples), APEOS (100% of samples), Chlorophenols (26 % of total samples), PPC (62% of total samples) heavy metals (82% of total samples), Allergenic and carcinogenic dyes (6% of total samples). Data analysis permits to establish a PRSL (Product Restricted Substance List) protocol for regenerated raw materials with the aim to have an unique PRSL available for brands, manufacturing companies and every actor involved in the textile supply chain. The PRSL adpotion could improve the recycling of textile materials as an alternative to their disposal.

TU344 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-Oritz, G. Janer, Leitat Technological Center

Cotton chemicals used in textile finishing processes are known to be toxic, persistent and bioaccumulative. Indeed, some of them (e.g., PFOA and DecaBDE) are listed in the Authorisation list and will be restricted after the sunset date. Alternative products are currently proposed by chemical companies for textile applications. Here we present two case studies (FLAREX and MIDWOR projects) focusing on the substitution of hazardous substances used as Flame Retardants (FRs) and Durable Water and Oil Repellents (DWOs). FRs are added to fabrics to inhibit the combustion process, and typically are products with a chemistry based on halogenates. DWOs are added to fabrics to repel water, oil and dirt, and typically are products with a chemistry based on long chain fluorocarbon polymers. These projects aim to support industry in the selection of alternatives. Alternative finishing additives available on the market were selected for laboratory validation of technical performance and industrial demonstration. In addition, a comparative risk assessment of conventional and these alternative formulations should be provided to ensure the reduction of environmental and health impacts. One of the main challenges for a comparative risk assessment of these products is that the active substances in most of them are polymers and therefore are not subject to registration under REACH regulation. The potential human and environmental impacts of these materials are related to their content or possible release of monomers (both with limited information). Moreover, the commercial formulations offered by chemical companies do not provide detailed composition. In fact, in the commercial products evaluated the chemical identity of the active substance was not reported in the safety data sheet. This is due to the lack of obligation to report ingrediants metals from ant-threying the hazardous classification of the mixture. Under this scenario, we propose to base the comparative risk assessment on the toxicological profile of the chemical family of corresponding monomers (based on the information supplied by the providers), and the operational conditions necessary for the application of each of the products (assuming that the risk mitigation measures will not change within an industrial setting). The results will support industry to select functional and safer alternatives.

TU345 Substitution of firefighting foams containing per- and polyfluorinated alkyl

H. G. Pyle, University of Lethbridge / Depatment of Biological Sciences; E. Lari, G.G. Pyle, University of Lethbridge / Biological Sciences

The large spectrum of activities focusing on the substitution of hazardous substances used as Flame Retardants and Durable Water and Oil Repellents. Alternative products are currently proposed by chemical companies for textile finishing applications. Here we present two case studies: flame retardants and durable water and oil repellents. The PRSL adoption could improve the recycling of textile materials as an alternative to their disposal.
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 biopesticides has been increased. Although a large number of studies have been published focusing on the biological activity of biopesticides on target organisms, studies regarding toxicological effects on non-target organisms, are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) has allowed the screening of several plant extracts for bio-activity against a selected set of crop pests and arthropod vectors. Some of these compounds have shown its effective value as biopesticides. 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 (hydrolysates) of them showed active compounds, being capable to act as biopesticides. 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 (Tarragon, Spain), Dittrichia graveolens (Ciudad Real, Spain), and an experimentally pre-domesticated Lavandula lauiieri (Toledo, Spain) using the algae Chlamydomonas reinhardtii as aquatic model organism. Results indicate that all of these extracts having biopesticide activity are likely to cause toxic effects on the photosynthesis of Chlamydomonas reinhardtii, being Lavandula lauiieri the most toxic compound followed by Artemisia absinthium with a very similar toxicity, and Dittrichia graveolens.

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TU349 Ecotoxicological evaluation of the hydroxlate byproduct of Satureja montana on Daphnia magna and Vibrio fisheri
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The increasing demand of natural bio-products for cosmetic use, food, or phytotherapy is based on the awareness about adverse effects on health and the environment. In particular, this work is focused on the plant Satureja montana (Lamiaceae), which has demonstrated a wide range of applications due to its important antioxidant and antiinflammatory properties. Furthermore, some species have a sweet flavor and simple cultivation characteristics. The main components, thymol and carvacrol (oxygenated monoterpenes), are supposed to be responsible for these biological activities. Although there are a substantial number of studies where Satureja species were evaluated for their biological and pharmacological activities, as well as its chemical characterization, limited data are available on ecotoxicological characterization. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydroxlate obtained from Satureja montana (Ejea, Aragón) 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 fisheri. Both tests are standardized for the purpose of determining the toxicity expressed as EC₅₀. Our results indicate that the hydroxlate of Satureja montana is likely to cause toxic effects on D. Magna and V. Fisheri but only at 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 (CQT2015-64049-C3-2-R)

TU350 The impact of the hydroxlate byproduct of three biopesticides on the soil environment
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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 biopesticides are, nowadays, being developed. Although biological activity of biopesticides on target organisms is well known, studies focusing on the effects on soil non-target organisms are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) focus 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 (hydrolysates) have been separated. Both of them showed active compounds capable to act as biopesticides. 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, Dittrichia 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 the initial community to degrade different carbon sources present in Biolog Ecoplates®. The acute toxicity of these hydrocarbons was also tested by Eisenia fetida bioassays. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and L. latifolia (LC50 in the range of dilution of 10-2). All three bioprecipitates 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. Burillo 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. Ko, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University Essential oils have exhibited their fungicidal 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 insecticidal effects (EOIs) on non-target organisms in the environment. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Rictina 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) and tergitol, they were mixed with ethanol and tergitol in a ratio of 5:1:4. Tergitol 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 AGEOb showed no mortality on the test fish during 96-hour incubation. Therefore, 48-1LC50 values for the VFEO 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. Ko, K. Kim, H. Jeon, Y. Choi, S. Lee. Kyungpook National University Recently, many researchers have developed natural insecticides to control insect pests and to protectplant 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 solvent and tergitol in a ratio of 5:1:4. Tergitol 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 AGEOb showed no mortality on the test fish during 96-hour incubation. Therefore, 48-1LC50 values for the VFEO 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.

TU353
Thiosemicarbazone scaffold for the design of antifungal and antiaflatoxicogenic agents: evaluation of ligands and related metal complexes
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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 consumers. Our research aims to develop new typologies of inhibitors of Aspergillus proliferation and of aflatoxins 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, some metal complexes were then synthesised. These molecules originally synthesized and characterized, were initially tested to determine their antifungal and antiaflatoxicogenic activity towards A. flavus. These compounds showed different efficacy in reducing fungal growth and mycotoxin accumulation. The most active compounds were used to perform cytotoxicity and genotoxicity tests on healthy human cells, particularly on human cell lines derived 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://aflatoxin.unibs.it/
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. Núñez, University of York / Environment; A. Praterius, University of York / 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 present a new environmental fate and transport model that 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
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Parabens (p-hydroxybenzoic acid esters), triclocarban (TCS) and triclocarban (TCC), have been extensively used in various cosmetics and personal care products (CPCPs) 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 CPCPs in our daily life. In this study, ten parabens and their metabolites, TCS and TCC were measured in 243 CPCPs, 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 (PP, 49%) and butyl paraben (BuP, 41%). TCC had only 20% of detection rate and TCS 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, eyeliner, body/hand lotions and lipstick. The daily exposure levels of parabens associated with the consumption of CPCPs were estimated using 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 CPCPs, 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 body 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 proportional allocation based on the amount of each product/brand in the market. Our results indicated that the consumption proportion 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 package food by age of children. These exposure factor characteristics could be useful input data for exposure risk and assessment for chemical regulation.

TU358
Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children
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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 their metabolites, such as isopropyl methylphosphonate (IPMP), diethylcarbamyl (TCPY, metabolite of chlorpyriphos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarbamyl 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-dethylamino-6-methyl pyridin-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-phenoxybenzoic acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxybenzoic 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 liquid chromatography tandem 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 most the 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
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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 (napthalene and phenanthrene) measured in placenta presented higher correlations than the high molecular weight PAHs (pyrene and benzo[a]pyrene). Moreover, increased levels of pyrene 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 napthalene, pyrene and BaP equivalents levels were found in homogenized placenta of mothers who smoked in the third trimester of pregnancy. No significant correlations were found between PAHs levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns 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
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and Environmental Sciences
The aggregate exposure pathway (AEP) model is a conceptual framework to help
alloccating unknow information including (i) production, use and release, (ii)
chemical fate and concentrations in various multimedia (urban and rural
environments, biota), (iiii) 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, quantifying chemical concentrations throughout the
source-to-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
(RAIRAD-ICE) modelling framework. RAIRAD-ICE includes direct and indirect
near-field exposures and can include far-field exposures for aggregate human
exposure assessment. The RAIRAD-ICE model is parameterized in this case study
for about 200 organic chemicals comprising a broad range of chemical properties
representative of commerical 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 PAHs from indoor pollution and as a point source to emission sources. Following the same exposure scenario, unit emission rate based
whole body concentrations (exposure potential) range from 3x10^3 to 5x10^4
mmol/kg. The differences in ranking chemicals for exposure based on either
external (intake fraction) or internal (exposure concentration) exposure metrics are
substantial due to chemical-specific differences in toxicokinetics. In absence of well
defined chemical use information, 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 EBNONY STATE IN 
SOUTH-EASTERN NIGERIA
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Biochemistry; P. Onyeyii, 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 Bkuyakum 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/OCHA 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 (UNEP/OCHA 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
quarry 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 needed 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
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der Horst, University of The Western Cape / SensorLab Department of Chemistry;
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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
aspects of environmental contamination. A bibliographic review of the papers
published over the last 5 years on the preparation, dissolution methods and
instrumental techniques with a focus on rare earth elements in electronic waste and
its disposal into the environment. Key words: Rare earth elements; electronic
waste; fusion optimisation; spectroscopy; wastewater

TU363 A stonework snail as a new biomonitor of metal contamination in the urban environment
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Sciences, Earth and Environment; N. Bianchi, University of Siena / Department
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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 infilues fine particles, is a promising indicator of metal contamination in urban environments. As a matter of fact, organisms widely used as biomonitors of urban pollution, i.e. mosses, lichens and
vascular plants, accumulate particles of soil and rock dust, making it difficult to
recognize the element contribution from atmospheric deposition and the metal
bioavailability to consumers. By analysing the chemical composition of the shells,
soft tissues and faeces of snails collected from vegetated walls, at roadside and
commercial sites, this study further investigates the preparation, dissolution methods and
analytical techniques. These methods of analysis including their adv
ances and release, (ii) dissolution and alkaline fusion are commonly employe
analytical methods with a focus on rare earth elements in electronic waste and
its disposal into the environment. Key words: Rare earth elements; electronic
waste; fusion optimisation; spectroscopy; wastewater

TU364 Metals Distribution in Urban Garden Soils in Greater Victoria, BC, Canada
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This study was conducted to determine heavy metal distribution in surface soils
in urban, semi-urban, and commercial sites in Greater Victoria, BC, Canada. Over
900 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
leaded paints and housing maintenance practices. Potential sources of the other metal
contaminants included the use of wood preservatives, septic fields, automotive

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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 suggested 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 agricultural production
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Among the national priority polluted sites, the SIN Brescia Caffaro is located in a mid size city Brescia, (200,000 inhabitants) in northern Italy. The site derived from the activity of the former Caffaro spa., a chemical factory among the largest former polychlorinated biphenyls (PCBs) producer in Europe, which produced such chemicals for more than 50 years up to mid 80'. About 100 Ha of agricultural areas and the cultivated urban area 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 rhizomeration potential
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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 contamination of trace elements 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 (Northern France) for three purposes: pasture, a future creation of a vegetable or 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.

TU367 Metals and metalloids in inhalable fractions of urban road dust
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Road dusts are highly enriched with metals and metalloids 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, focusing 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 diameter size 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 (8.2 vs. 2.2 µg/g) and Pb (80 vs. 54 µg/g). The enrichment of elements of known toxicology 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 its concentration in the city-wide air, and its contribution to road dust. These data also have significant implications for urban health and safety, providing insights into exposure to heavy metals in urban environments, including both the inhalable fraction and bulk metals that may be ingested. The results of this study also have important implications for urban sustainability, demonstrating the importance of non-vehicle emissions to urban health, and the need for further investigation of this important source of metals in urban environments.
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Organophosphate esters (OPEs) have been measured at relatively high concentrations globally in remote to urban locations with highest levels in indoor environments. Studies of OPEs often comment that these are “new” compounds, citing their use as replacements of some now-restricted brominated flame retardant. Here, “even newer” organophosphate esters were investigated in this study of dust samples from several locations with varying site types. The sample locations and types tested here include dust from Canada (houses from Vancouver and Toronto), Turkey (homes and offices from Istanbul), and Egypt (homes, offices and cars from Cairo), dust from an e-waste facility in Toronto, Canada, and NIST house dust (SRM 2583–2585 from American homes).

The OP-values for polycyclic aromatic hydrocarbons (PAH) found in NIST SRM dusts that were collected in the mid-1990s were much higher (by two orders of magnitude) than those for polychlorinated biphenyls (PCBs). OP-values for PAH are typically lower than for PCBs except for dibenzofluoranthene (DBF) and dibenzo-p-dioxin (DBD). The OP-values for PAH are typically lower than for PCBs except for dibenzofluoranthene (DBF) and dibenzo-p-dioxin (DBD). The OP-values for PAH are typically lower than for PCBs except for dibenzofluoranthene (DBF) and dibenzo-p-dioxin (DBD). The OP-values for PAH are typically lower than for PCBs except for dibenzofluoranthene (DBF) and dibenzo-p-dioxin (DBD).

The scientific world is still questioning about the effects of airborne particulate matter (PM) concentration and composition on human health, and different scientific approaches have been evaluated in order to gain information about it. The measurement of oxidative potential (OP) is generally considered as a predictive index of PM ability 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 (dithiothreitol - DTT, acid ascorbic – AA, and 2',7'-dichlorofluorescin –DCFH; Fang et al., 2016; Huang et al., 2016) to PM1.0/PM2.5 samples and to size-segregated dust samples collected by a 10-stage impactor. Performances were evaluated at an industrial site near Ferrara (Po Valley; Italy) and at a traffic urban site in Rome (Italy). All the samples were also analysed for anion, cations, macro- and micro-elements, total organic content, elemental carbon and water-soluble organic content, in order to identify the relationships between OP values and PM chemical composition and dimension. Despite the very different composition of PM in the two monitored areas, OP values were scarcely dependent on the sampling site: two monitored areas, OP values were scarcely dependent on the sampling site: two monitored areas, OP values were scarcely dependent on the sampling site: two monitored areas, OP values were scarcely dependent on the sampling site: two monitored areas, OP values were scarcely dependent on the sampling site: two monitored areas, OP values were scarcely dependent on the sampling site:

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-phenyleediamine (DPD) method has been without any doubt the most common procedure for the analysis of free and combined chlorine (chloramines) and also, chlorine dioxide. While this method easily permits the differentiation between free and combined chlorine, the selectivity of the analysis of chlorine dioxide when chlorine is present has recently been questioned. As a result, this procedure has been removed from Standard Methods (American Water Works Association) and qualified as “reserved” method. Give this circumstance and the need of having a selective method for chlorine dioxide, several UV-VIS spectroscopic methods have been evaluated by our group (1). Here, the results using leucemethylene blue are presented. This chromophore agent is obtained by reduction of methylene blue and its use for the analysis of chlorine dioxide is scarcely described in the literature. Our experiments show that it presents a good analytical performance, and what is more important, measurements are not interfered by elemental chlorine. The 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 among the different compounds that we have used – ammonium, lissamine green, and chloro phenol methyl red-. The only drawback of the procedure is the interference by high concentrations of sulphate. Ongoing work is taking place to avoid it by previous precipitation of the interferent or liquid extraction of the dye before analysis as proposed for its development. (1) P. López et al. Chemical and sensory analysis of chlorine dioxide in drinking water. Part II. SETAC Europe 26th Annual Meeting. May 2016. Nantes (France).

TU372
Longevity in marine planktonic foraminifera: A new field test for the determination of the species environmental preferences.

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Marine planktonic foraminifera are small (40–500 μm) unicellular marine protists belonging to the Foraminifera class. They are ubiquitous in the marine environment and play a key role in the global carbon cycle. Foraminifera can be used as indicators of environmental conditions and can be used to reconstruct past environmental conditions. However, the determination of the species environmental preferences is still a challenge.

To fill this gap, we present a new field test for the determination of the species environmental preferences. The test is based on the analysis of the sedimentary record of species abundances in shallow marine environments. The test was applied to the sedimentary record of species abundances in shallow marine environments. The test was applied to the sedimentary record of species abundances in shallow marine environments. The test was applied to the sedimentary record of species abundances in shallow marine environments.

The results showed that the test was able to determine the environmental preferences of species. The results showed that the test was able to determine the environmental preferences of species. The results showed that the test was able to determine the environmental preferences of species. The results showed that the test was able to determine the environmental preferences of species. The results showed that the test was able to determine the environmental preferences of species.
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 connecting 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.nimbiros.org/workinggroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of the mechanistic impacts of the 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 managing for provision of the SGC ecosystem services will provide different 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
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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 these 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, Altiera, Wageningen University and Research Centre / Environmental Risk Assessment Team; F. Bigler, Retired; G. Frampton, University of Southampton; C. Hogstrand, Kings College London / Division of Diabetes and Nutritional Sciences; R. Luntik, Retired; F. 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, guiding the integration of technical knowledge derived from means of exposure, 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 recovery processes in space and time caused by natural or human-caused events, 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 means of setting a spatial, temporal and functional habitat baseline. HEA was 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 resilience 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 project planning varies in scale, and how long 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. The new EU regulations on severe accidents (SEVESO Directive 2012/18/EU) define specific requirements and specifies that risk management actions (RMAs) are in close proximity to water bodies, the coast, and or protected conservation areas. Site safety reporting requires an initial risk assessment be undertaken. The assessment draws upon both the potential severity of harm and environmental recovery in order to determine the risk tolerability under accidental release scenarios. Industry guidance exists on the evaluation of harm, but corresponding guidance on the prediction of environmental recovery was, until recently, limited. On behalf of 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 resource and type of services. The guide 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 provide the benefits equivalent to the damage avoided. The analysis incorporates 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. Moeijari, 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. Composed by activated events, with respect to damage assessment, 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 defining, if not almost impossible, to develop and implement rational and cost-effective strategies to manage their 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 usage, 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 known 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 environmental and reputational liabilities.

TU383
Use of cost modelling techniques to manage environmental subsurface risks, liabilities and uncertainties in Spain
P. Wouters, M. Ferreira, I. Harper, Ramboll Environ / Environment and Health; M. Canedo, Red Eléctrica de España
Companies owning large portfolios of properties are often faced with a high degree of uncertainty in relation to the subsurface conditions of their sites. This makes it difficult, if not almost impossible, to develop and implement rational and cost-effective strategies to manage their 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 usage, 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 known 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 environmental and reputational liabilities.

TU384
Quality stakeholder involvement for resilience in environmental risk
320
SETAC Europe 28th Annual Meeting Abstract Book
assessment
Y. Tomkiv, Norwegian University of Life Sciences (NMBU) / Faculty of Environmental Sciences and Natural Resource Management; B. Wynne, Norwegian University of Life Sciences / Centre for Environmental Radioactivity CERAD CoE; D. Oughton, Norwegian Public Roads Administration / Norwegian University of Life Sciences / Centre for Environmental Radioactivity (CERAD CoE).

There is a global call for sustainability and systemic approaches in environmental risk assessment that consider economic and societal aspects of risk, in addition to the environmental aspect. Early and effective stakeholder involvement plays fundamental role in these considerations. Stakeholder involvement is actively utilized in both policy and research, moreover, it is widely recognized that stakeholders will increasingly influence future consideration of environmental risk and assessment, including decision-making. However, it is important to ensure the quality of the stakeholder involvement activities in order to support democratically legitimate and robust processes. However, the existing systems of criteria tend to be focused on a rather narrow evaluation of the method applied. We argue that there is need for evaluation that goes beyond a simple assessment of the methodology and address the wider context that the stakeholder involvement activity is held in.

This paper uses two stakeholder engagement events: one from the field of emergency preparedness and one from nanomediazed, to explore the applicability of existing evaluation criteria for a quality assessment of stakeholder or broader public involvement. We use criteria developed by Rowe and Frewer (2000), namely, representativeness, independence, influence, transparency and early involvement. The results showed that the stakeholders, particularly with young children, are too much on the acceptance of the outcomes rather than the process itself and, as such, are not sufficient for assessing the quality of a stakeholder engagement. We will present proposals for extended criteria that address the limitations and highlight the principles for a more democratic stakeholder involvement. Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. Science Technology & Human Values, 25(1), 3-29.

TU385 Assessment and Management of Radiation Risks following a Nuclear Accident: The Shamisen Project Recommendations
D. Oughton, Norwegian Public Roads Administration / Norwegian University of Life Sciences / Centre for Environmental Radioactivity (CERAD CoE); E. Cardis, ISIGlobal; T. Schneider, CEPN; Y. Tomkiv, Norwegian University of Life Sciences / Centre for Environmental Radioactivity CERAD CoE.

The Fukushima Daichi accident in 2011 represents a poignant reminder of the complex interplay between environment, society and economics. Contamination of both terrestrial and marine ecosystems had wide reaching impacts for the affected populations. While the strict control of foodstuffs ensured that the radiological impacts on human health were minimal, the economic and societal consequences have been enormous. The loss of livelihood from bans on fishing and farming have hit farming and fishing communities, exacerbating the already existing concern for recruitment of younger generations to family businesses. The return of evacuees to derelict and uninhabited areas has been slow, particularly for families with young children, leading to demographic changes in societies. Other social and cultural impacts arise from lack of access to beaches, places of heritage and festivals. The economic consequences from food bans go beyond the loss of sales, market value decreased in all products from the area due to loss in consumer trust (20% decrease compared to the rest of Japan). Strategies for radiation risk management are often at odds with the actual needs of the affected populations, and if not carried out properly can cause more harm than good. Recognising this, the EU SHAMISEN project has published a set of recommendations to improve radiation risk management after a nuclear accident. Experience suggested that existing systems of criteria tend to be focused on a rather narrow evaluation of the method applied. We argue that there is need for evaluation that goes beyond a simple assessment of the methodology and address the wider context that the stakeholder involvement activity is held in.

This paper uses two stakeholder engagement events: one from the field of emergency preparedness and one from nanomediazed, to explore the applicability of existing evaluation criteria for a quality assessment of stakeholder or broader public involvement. We use criteria developed by Rowe and Frewer (2000), namely, representativeness, independence, influence, transparency and early involvement. The results showed that the stakeholders, particularly with young children, are too much on the acceptance of the outcomes rather than the process itself and, as such, are not sufficient for assessing the quality of a stakeholder engagement. We will present proposals for extended criteria that address the limitations and highlight the principles for a more democratic stakeholder involvement. Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. Science Technology & Human Values, 25(1), 3-29.

TU386 SETAC Ecosystem Services Interest Group
S.E. Aptiz, 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. Mohamed Ali, 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 (PM10) concentration and the equilbrium equivalent radon (EQRn) concentration in two university buildings with different ventilation systems. A low volume sampler using Telefon filter paper was used to collect the PM10 samples and indifferently 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 carcinogenic and non-carcinogenic trace elements was also determined based on the US EPA standard. The equilibrium factor and the annual effective dose on the lung cancer risks of each occupant were calculated and a correlation of the radon concentration was made with the annual inhalation dose of the occupants at the indoor stations. The results showed PM10 concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 µg m⁻³ and 23.4 to 159 µg m⁻³, respectively. In Buildings 1 and 2, the principal component analysis and multiple linear regression showed that the main source of pollutants in PM10 were from the crustal source (20%) and combustion (21%), respectively. The effective lifetime carcinogenic risks (ELCR) in Buildings 1 and 2 were 1.90E-3 and 1.65E-4, respectively. The hazard quotient (HQ) represents the non-carcinogenic risk, with 7.73 and 6.46 in Building 1 and Building 2, respectively. The average equilibrium equivalent radon measured in Building 1 and Building 2 was 2.33 ± 0.89 and 3.17 ± 1.74 Bq·m⁻³, respectively. The average annual inhalation doses recorded at Buildings 1 and 2 were 0.014 ± 0.005 mSv y⁻¹ and 0.020 ± 0.013 mSv y⁻¹, respectively. For trace metals, the ECLR and HQ values were found to exceed the permissible limits suggested by US EPA, whereas the values of equilibrium equivalent radon concentration were still below the standard recommended by ICRP.
Among the different air pollutants found in schools, PM$_{2.5}$ (fine 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 performed a present study. On it, we collected two fractions of fine PM (PM$_{2.5-10}$ and PM$_{0.25-0.5}$) in six classrooms of three school located under the influence 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 school managers and parents.

TU390

Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Y. Lan, C. Chang, C. Chung, China Medical University

Abstract The purpose of this study was to assess the effects of extremely high air temperature 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 extreme hot temperatures (99th 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 23.67°C 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 F. Li, Jinan University; J. Zhou, C. Wu, L. Bao, L. Shi, J. Y. Zeng, Jinan University / School of Environment

Abstract The present study conducted thermal treatment and open burning of typical e-wastes, i.e., plastics and printed circuit boards. Emission factors of the суммарных масс PBDE were 817×10$^{-6}$ g from printed circuit boards and 1.16×10$^{-6}$ g from plastic casings. The open burning process was characterized by a progressive increase in the output mass ratios of ∑PBDE (0.21–10 in thermal treatment and 0.01–0.36 in open burning. All PBDEs were largely deposited on fine particles, with geometric mean diameters at 0.61–0.83 µm in thermal degradation and 0.57–1.16 µm in open burning from plastic casings, compared to 0.44–0.56 and RL–0.55 µm from printed circuit boards. The main emission mechanisms for lightly and heavily brominated PBDEs were suggested to be evaporation and mechanical formation, respectively. The difference between the size distributions of particulate PBDEs in emission sources and adjacent air implied a noteworthy redeposition process during atmospheric dispersal.

TU392

How risky is the schoolyard? An approach from chemical composition of particulate matter F. Reina, School of Civil Engineering, Universitat Rovira i Virgili / Chemical Engineering; L. Reina, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Department d Enginyeria Química

According to last estimations, there are globally around 6.5 million deaths caused by fine particulate matter (PM) each year. The main carriers of fine PM are traffic-related and gaseous constituents (0.3%), in thermal treatment, while they were 30%, 43% and 50% in petrochemical, and chemical environments respectively. Among the different air pollutants found in schools, PM$_{2.5}$ 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$_{0.5}$, 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 TH-470-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer).

TU393

Good news to lazybones kids: increasing sleeping time decreases exposure to airborne particulate matter F. Sánchez Soberrón, Universitat Rovira i Virgili / Chemical Engineering; F. Noardo, Universitat Rovira i Virgili / Department of Chemical Engineering; M. Martínez-Marín, Universitat Rovira i Virgili / Department d Enginyeria Química; M. Schuhmacher, Rovira i Virgili University / Department d Enginyeria Química

Abstract Particulate matter (PM) is a complex mixture of extremely small particles (＜10 µm) and liquid droplets suspended in the atmosphere. They are originated from a wide range of sources (such as traffic, industry, energy production or domestic combustion). Nowadays, the inhalation of this pollutant is a concern due to its potential to cause irritation and inflammation of respiratory airways, asthma attacks, and lung cancer. These effects are especially pernicious in kids, since their inhalation rates are higher, and their immune system is still not fully developed. However, most studies dealing with human exposure to PM are focused on adults. 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 (MPP2D11, ARA) made possible to know the deposition pattern of the different PM sizes within the distinct parts of the respiratory tract. Indoor/outdoor ratios of PM levels were variable among schools. Half of the schools presented higher concentrations of PM indoors, while the other half showed the opposite trend. Simulations indicated the great influence of PM$_{0.5}$ indoors, due to its easier capacity of infiltration from outdoors. Despite sleeping was the most time demanding activity, deposition fractions into the lung during these sleeping hours reached the minimum values. On the other hand, although moderate and high intensity activities accounted for 25% of time, these activities were responsible for the retention of 50–75% of overall PM mass. Most of this mass was deposited into the inspiratory airways, due to sedimentation processes. Tracheobronchial region registered the lowest values of deposited particles, while PM retained in the lung was mostly PM$_{1}$ and PM$_{2.5}$. Results from this study will help to take actions regarding indoor air quality and perform more accurate risk assessment studies.

TU394

Occupational Cement Dust Exposure: effect on blood level of some antioxidant enzymes and vitamins in Overeri, Nigeria. C. Ikaraoha, J. A. Egeono, Imo State University Owerrri, Imo State, Nigeria / Chemical Pathology Unit Dept of Medical Laboratory Science; C. Unahide, Imo State University Owerrri, Imo State, Nigeria / Medical Laboratory Science; N.C. Mbadiwe, University of Nigeria Teaching Hospital, Enugu, Nigeria / Medicine; J. Dike-Nudim, Imo State University Owerrri / 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. The objective of the present study was to determine the effect of cement dust exposure among Cement workers in Nigeria. We selected 105 workers/dealers in Nigeria. The Effect of cement dust exposure on the blood levels of some antioxidant enzymes and vitamins was determined. Following were the results: The activities of the antioxidant enzymes such as glutathione peroxidase, superoxide dismutase and catalase (CAT) were determined using ELISA spectrophometric 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,
Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds for the individual PAH bioaccessibilities between with and without adding glass microfibers 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 lung fluid, Gamble’s solution to particle-bound PAHs was reduced by more than 90% if the size-depend PAHs bioaccessibility and deposition efficiency were involved into the assessment.

TU397 Toxicity does not vanish into thin air - molecular mechanisms of air pollutant mixtures

H. Lin, National Taiwan University; Y. Lin, National Health Research Institutes / National Taiwan University / Department of Environmental Science; P. Kukucka, P. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; K. Pukucka, P. 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 PM fraction of the particulate phase, stage I of mixture analysis was carried out. The easily inhalable fine and ultrafine aerosols were selected to perform the Intensive Rearing of Poultry and Pigs. Different mitigation strategies can be applied to determine the effectiveness of mitigation options: the SHERPA 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 environment. An example of an all integrated system of NH mitigation is the process of manure storage and spreading. The reduction of NH emission from pig farming management steps can have a positive effect in NH-related impact categories, such as PM formation, terrestrial acidicification and eutrophication.

TU396 Development of an In Vitro Method to Evaluate the Inhalation Bioaccessibility of Particle-Bound Hydrophobic Organic Chemicals and its Effects of Particle Size

Lee-Sung Jinn University; L. Bao, E.Y. Zeng. Jinn University / School of Environmental Science; P. Kukucka, P. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; K. Pukucka, P. 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 PM fraction of the particulate phase, stage I of mixture analysis was carried out. The easily inhalable fine and ultrafine aerosols were selected to perform the Intensive Rearing of Poultry and Pigs. Different mitigation strategies can be applied to determine the effectiveness of mitigation options: the SHERPA 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 environment. An example of an all integrated system of NH mitigation is the process of manure storage and spreading. The reduction of NH emission from pig farming management steps can have a positive effect in NH-related impact categories, such as PM formation, terrestrial acidicification and eutrophication.
Towards green braking: comparative evaluation of toxicological profile of particles generated by traditional and innovative braking systems.

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The protection and improvement of air quality are key critical points of environmental planning on a local, national and international level. 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 EU/28. 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 traffic 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/IT/000492) project aims to create a safer alternative to the 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. Kruk, G. Domon, S. Domon, U.S. Environmental Protection Agency, National Exposure Research Laboratory; S.L. Massey Simonich, C. Roper, Oregon State University / Department of Environmental and Molecular Toxicology; A. Zielonuk, Pacific Northwest National Laboratory; K. Suski, Pacific Northwest Laboratories Oxidized transformation products (OTP) of polycyclic aromatic hydrocarbons (PAHs) have been measured in a series of thin-film deposition experiments using PAHs, the paper will present the occurrence of oxidative transformation products of phenanthrene measured in laboratory generated secondary organic aerosol particles. Recent laboratory studies indicate that SOA particles formed in the presence of gas-phase PAHs contain both parent PAHs and their OTP. In laboratory experiments of α-pinene SOA particles, OTP of phenanthrene, a model three-ring PAH, were observed in varying ratios. Developmental toxicity testing with zebrafish (Danio rerio) will be conducted using embryos (32/treatment) that will be dechorionated and placed into 96-well plates containing OTP of phenanthrene in observed ratios at 6 hours post fertilization. Developmental toxicity will be assessed by measuring growth changes, embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post fertilization. Evaluation of the oxidative potential of the SOA samples as well as individual compounds and observed ratios of compounds is underway using the diethylthi-clorite (DICT) consumption assay. The results from both assays will be discussed.

TU401 Chemical analysis and risk assessment for toxic compounds in PM2.5 in Gwangju, Korea

I. Kim, Gwangju Institute of Science and Technology; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering Particulate matter (PM), a mixture of solid or liquid matter found in the air, has gained considerable attention as a major air pollutant in recent years. Recently, it is revealed particulate matter, especially PM2.5 (aerodynamic size < 2.5 μm) cause numerous diseases such as respiratory, cardiovascular diseases, asthma and so on. The prime criteria for preventing the adverse effects of PM2.5 are based on the mass concentration, but recent research has shown that the chemical composition of PM2.5 can be a more important factor for determining PM2.5 toxicity than mass concentration. Many researchers reported the diverse chemicals in PM2.5 such as inorganic sulfates and nitrates, black carbon, metal, organic compounds, and others. In addition, a few studied detected organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in PM2.5 of China. However, there is no research on OCPs and PCBs within PM2.5 in Korea. In this study, we developed the rapid analysis method for toxic compounds (PAHs, OCPs and PCBs) in PM2.5 using accelerated solvent extraction (ASE) and thermospray (THERMOSP) mass spectrometry. PAHs data in Korea was collected from Oct. 2016 to Apr. 2017 (for 21 weeks). We determined the toxic compounds in the collected PM2.5 using the developed method and metal concentration in PM2.5 was also analyzed using microwave extraction. Cr, As and Cd showed high concentration in PM2.5 of all sites and several OCP and PCBs also detected. Lastly, we did the risk assessment on metals, PAHs, OCPs and PCBs in PM2.5 of Korea to determine the risk potential of OCPs and PCBs among the total risk of PM2.5. Our research is a valuable report on OCPs and PCBs in PM2.5 of Korea and suggests the practical method for screening trace toxicants in PM2.5.

TU402 Source apportionment study of PM10 and PM2.5 using selective wind direction sampling technique in the area of Civitavecchia (Italy)

T. gagliardi, Istituto Superiore di Sanita’ / Environment and Health; G. Settimio, m. Inglessis, Istituto Superiore di Sanita’ / Department of Environment and Health; g. marsili, osservatorio ambientale; m. sogliu, Istituto Superiore di Sanita’ / Department of Environment and Health The characteristics of particulate matter (PM) 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 aerosols 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. A descriptive 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 (PM10, PM2.5, 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 PM2.5 concentration. Thus, non-linear models combining multiple linear regressions with exponential regression were subsequently developed to describe the hygroscopic growth and the attenuation of PM2.5 in the air pollutants and meteorological parameters around the whole globe. 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 and PM10

E. Nagashima, Kyushu University; K. Nansai, National Institute for Environmental Studies; S. Chatani, National Institute of Environmental Studies; S. Kagawa, Kyushu University Analyzing the Asian supply chain structure of health impacts with PM2.5 and PM10 (TU404). Setacci Europe 28th Annual Meeting Abstract Book 324
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 particle matter (PM$_{2.5}$) have caused some severe environmental and human health problems. With the rapid research motivation, the health impacts associated with the PM$_{2.5}$ through the Asian supply chains have been estimated in the previous researches. 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 industrial sector from the Emission Scenarios Database for Global Atmospheric Research (EDGAR) emission inventory data, Weather Research and Forecasting (WRF) model and CMAQ modeling system, and then estimated 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 contribution dominates on the PM$_{2.5}$ emissions in Asian are estimated 50% and we revealed top ranking supply-chain paths 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
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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 some contribution to secondary PM$_{10}$ emissions in August were estimated 185 ìg/m$^3$ on the particles from terrestrial sources. The objective of this work is to fill the lack of knowledge about the impact of emissions resulting from the marine compartment. It includes natural emissions such as sea salts [1] and anthropogenic emissions linked to the marine traffic especially in the English Channel, that forms a narrow corridor with one of the greatest concentrations of shipping in the world (up to 800 vessels sailing per day). PM$_{10}$ sampling and measurement campaign were performed continuously during one year in 2013 at Cape Gris-Nez, a coastal French site located in front of the Straits of Dover. PM$_{10}$ levels were measured using MPI01 analyzer (Environment SA®) and collected using the DAB8 sampler (Digiflote® 30 m$^2$/h) on a daily basis. The characterization of PM$_{10}$ was performed considering major and trace elements, water-soluble ions, EC/OC as well as tracers of biomass burning (levoglucosan), primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanesulfonate ions). These chemical parameters were used to explain PM$_{10}$ levels on the coastal site, identify PM$_{10}$ sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non Negative Matrix Factorization (CN-NMF) model: fresh sea-salts, aged sea-salts, secondary nitrates, secondary sulphates, crustal, biomass combustion, primary biogenic emission, marine traffic, combustion, metal source. The monthly evolution of their contribution evidenced different behaviours between the sources: secondary nitrates were predominant during the cold season and appeared to be the most involved in the PM$_{10}$ concentration peaks. The impact of marine traffic and a high proportion of sea-salts versus fresh sea-salts was mainly evidenced during the summer season. For the year 2013, the mean contribution of the different sources were 37% for sea-salts and aged sea-salts, 43% for the secondary inorganic aerosols, 7% for biomass combustion, 5% for marine traffic. This distribution varies highly depending on the period and more particularly during exceedances of daily PM$_{10}$ limits values.

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; J. 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+ chemical species. Here we report the first comprehensive high-resolution real-time monitoring and modeling system in the world, and further computes population health exposure by inhalation and ingestion. From an emitter perspective, the spatial distribution of population implications show high spatial variations in intake fractions from 0.68 to 33 ppm for benzene, 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 point sources were examined for human exposure via inhalation and ingestion. This distribution evidences the importance of different selectivity when it modified the D$_{DNA}$ adducts in follicular cells from isolated ovarian follicles that were exposed to PAHs. The results showed that two oxidative biomarkers, 8-epi-prostaglandin E$_{2}$-diol (8-iso-PGF$_{2}$α) and 8-epi-prostaglandin F$_{2}$-diol (8-iso-PGF$_{2}$α), had strong correlations with the three DNA adducts, 7,8-dihydrodiol-9,10-epoxide-dG (BPDE-dG), phenanthrene 1,2-quinone-dG (PheQ-dG), B[a]P 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-hydroxy-2-deoxyguanosine (8-OH-dG) and 8-isoprostane (8-isoP), had strong correlations with the three DNA adducts, BPDE-dG, BPQ-dG, and PheQ-dG, suggesting a strong link between the formation of covalent DNA adducts and DNA damaging oxidative stress. The method has also been successfully applied to investigate the selectivity of chemicals to modify the nitroso-derivatives 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.

TU407 Global inter-comparison of polycrylate foam passive air samplers evaluating variability due to sampler design and analysis
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SETAC Europe 28th Annual Meeting Abstract Book
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 semi volatile 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 the most used of the global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use simple 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 spectral and 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 Imagining Quantities of Polyurethane Foam Passive Air Samplers (PUF PAS) from around the world and deployed them in a multi-part built to imitate the human respiratory system. The mannequin takes in air 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 in 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 128x128 Mercury Cadmium Telluride (MCT) detector. The samples have been imaged 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
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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 one of the most versatile and inexpensive manufacturing technologies to prepare nanofibers and develop nanostructured sensors for volatile organic compounds (VOCs) in the air. Sensors based on polymer 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 (sensitivity and selectivity). Therefore, electrospun nanofibrous and environmentally friendly materials have been designed and fabricated for detecting pollutants. 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-tritylphosphorylphosphinates) 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 and good analytical performance have been obtained by using 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 filtration.

TU411
Determination of Cross Compartment Concentration Gradients of Polymeric Aromatic Hydrocarbons using PE Passive Samplers
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Extensive research has been performed on indoor air quality (IAQ) over the last decades. This included determining mechanisms of deposition in lungs and on the interior. The environment. Samples have been divided up into continuous sampling and 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 built to imitate the human respiratory system. The mannequin takes in air 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 in 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 128x128 Mercury Cadmium Telluride (MCT) detector. The samples have been imaged 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.

TU412
Evaluating Computational and Structural Approaches to Predict Transformation Products of Atmospheric Polycyclic Aromatic Hydrocarbons
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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 PAHs (EPA) are a major cause for concern, and have been used to develop sensors for gas monitoring. This provides information on the comparative design of 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 at this interface as well as the atmospheric flux direction. Atmospheric measurements 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 equilibrated ex 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 at this interface as well as the respective flux direction. Atmospheric concentrations could trigger a change of equilibrium conditions between soil and atmosphere. This illustrates the main objective of the study: The determination of the actual flux direction of PAHs across the soil-atmosphere interface. Polyethylene (PE) passive samplers have been used to detect sensors for gas monitoring. This provides information on the comparative design of 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 at this interface as well as the respective flux direction. Atmospheric concentrations could trigger a change of equilibrium conditions between soil and atmosphere. This illustrates the main objective of the study: The determination of the actual flux direction of PAHs across the soil-atmosphere interface.
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 NPAH, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clár’s resonance structures were able to best predict the local electron rings 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 of the environmental 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

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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, inexistent 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 begun in 2010 by deploying a pair of PAS containing one cartridge of XAD2 resin on each site. Resins were deployed for 12 months during 3 consecutive years at 42 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 Wanja et al. (2003). XAD-2 resins were extracted by hexane:dichloromethane (1:1), purified and analyzed by gas chromatography/mass spectrometry (GC/MS). Although PAHs are higher (p< 0.005) in horses exposed to polluted air (Slavonski Brod site) when segments were analysed according to 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

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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 potential 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 were significantly different 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 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 putting 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. Oitojo, University of Nigeria Nsukka / human nutrition and dietetics; O. Oitojo, 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, cellulose 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 in 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, difluoromine, Hexanoic acid, Amyl nitrite, Tolulene, Butenenitrite, 2-Butenal, Thirane, Nonanoic acid, Ethylendiaminedia, Furfural, Hydrogen azide, 2-pentene, Formic acid, and ocatic acid; with Acetic acid occurring the most and Argon, Allene, and Difluoromine occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannopentulose, 45% hexanoic acid, 25% propane-1- ethynylthio and had other VOCs ranged 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-butenemine 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. Mulhearn, 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. Vasicikova, M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); P. Koushova, 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); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX Application of pesticides, including conazole fungicides (CFs), is an indispensable part of modern agricultural management, contributing to food security and safety. Conazoles are a class ofazole-based fungicides, commonly used to prevent fungal growth on turf grass and agricultural crops. CFs are still widely used despite their non-target ecotoxicity in water, chronic toxicity to mannnals with hepatotoxicity, carcinogeticity, reproductive toxicity and endocrine disruption. For example, in the EU classification, epoxiconazole and fluazilazole are suspected carcinogens [1]. Presence of such compounds in arable soils represents potential short- or long-term environmental threat with a wide range of possible negative impacts on ecosystem services and health. Hence, risk assessment considering various non-target taxonomic groups of vertebrates, invertebrate and plant species, should be performed. The objective of the present work was to assess the ecological risks of conazole fungicides based on the data from the comprehensive survey of pesticide residues in 75 agricultural topsoil floodplain locations in the Czech Republic acquired in early 2015 [2]. In this study, 51 currently used pesticides and 9 transformation products were analysed by multi-residue pesticide analysis on LC-MS/MS after soil QuEChERS extraction. The data indicated that over 70% of soils contained at least one CF and the total concentration of CFs exceeded 0.01 mg/kg in 53% of soils. Epoxiconazole and tebuconazole also frequently exceeded 0.01 mg/kg (in 25% and 33% of soils, respectively). Three further CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by fludioxonil (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 – ec.europa.eu/food/plant/pesticides/ue-pesticidevdatabase; [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 samples
N. Neuwirthovã, Masaryk University; Z. Bilkova, Masaryk University / RECETOX; J. Vasicikova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Breilska, Masaryk University / Faculty of Science RECETOX
In this study, the dissipation and partitioning dynamics and the extent of biota uptake were measured and modeled for selected hazardous current-used fungicides (prochloraz, tebuconazole, fluazilazole, epoxiconazole), insecticide (chlorpyrifos), and 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 compound and its sorbed fraction along with the non-sorbed component were normalized sorption coefficients (Koc) 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 by compound partitioning. This was evidenced by the ability of Cmax to reliably (r² = 0.994) predict root uptake. Concentration of parent compounds did not exceed the maximum residue levels (MRLs) for lettuce. Koc values were in the range of literature values and were shown to increased (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 pose limited risks when presented in the soils for a given time. They were shown to be not persistent (except for 2-hydroxyatrazine), b) to accumulate in lettuce to extents 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 – ec.europa.eu/food/plant/pesticides/ue-pesticidevdatabase; [2] M. Hvezdova, et al., Sci. Total. Environ., vol. 613–614, pp. 361–370, 2018.

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. Dévier, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS, K. Le Menach, P. Pardon, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; G. DUPORTE, Université de Bordeaux / EPOC UMR 5805; F. Macary, Iristea Bordeaux; H. Budzinski, 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 water were monitored during a year using polar organic chemicals integrative sampler (POCIS) retrieved monthly together with grab water samples collected monthly or bimonthly. Four sites with intermittent-flowing were monitored using grab water samples only. Passive samplers such as POCIS enable the improvement of limits of quantification (LOQ) and estimation of time-weighted average concentrations over the exposure period for hydrophobic compounds. The POCIS samples collected on 50 pesticides were targeted including 23 fungicides currently applied in the studied catchment. Extracted samples were analysed by liquid chromatography-tand mass spectrometry (LC-MS/MS) and gas chromatography-tand 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 dimetomorph. Fungicides such as cyprodinil, kresoximin-ethyl and iprocarb
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

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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 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 cells were cultured in a minimal essential medium supplemented with 10% fetal bovine serum (v/v), penicillin (100 mg/ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment. with 5% CO<sub>2</sub> (v/v), at 37 °C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein damage in Petri dishes (7.5×10<sup>3</sup> cells) and for genotoxicity parameters in Petri dishes. From the MTT assays, the LC50 was determined (29.88 (25.99-34.37) 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 micronucleus 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. 

**TU424**

Intra-tracheal administration of the disinfectant, 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 toxicity assessment

The symptoms observed in the cells were minimal in the samples and the control. CMIT/MIT, have remain unsolved. This is mainly due to a lack of concordance between the few available toxicity tests and the abundant epidemiological data, thus making it difficult to establish a cause-and-effect relationship. Therefore, this study was carried out to investigate any potential associations between CMIT/MIT exposure and death. Methods: Groups of experimental and control C57BL/6 mice were instilled in the trachea with a chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), using a visual instillator. CMIT/MIT was instilled over a period of 3 days and 8 weeks, respectively, to achieve acute and chronic exposures. A threshold dose-response model was applied for estimating the threshold level as one line of evidence for a causal association between CMIT/MIT and death. Results: An acute exposure of 1.2 mg/kg/day of CMIT/MIT was estimated to reflect the threshold for death. The dose-response curve with this threshold showed a very steep slope and a narrow range of CMIT/MIT exposures. A narrow range of CMIT/MIT exposures, in particular, indicated an evident boundary between survival and death, thus implicating a strong causal association. A similar threshold dose-response relationship observed following acute exposure was also seen following chronic exposure to CMIT/MIT. Airborne disinfectant exposure was visible as minimal or mild lung damage with no fibrosis, as shown by histopathological tests. However, many observations are considered to be functional respiratory tract, as observed in necropsies of the mice that died due to CMIT/MIT exposures. Conclusions: There are two strong lines of evidence for a causal association between death and CMIT/MIT exposure: 1) a threshold dose-response curve, with a very steep slope and a narrow range of CMIT/MIT exposures showing a visible boundary between survival and death, and 2) functional respiratory tract failure except lung fibrosis. Thus it is concluded that CMIT/MIT exposure would cause the death without lung fibrosis.

**TU425**

Genotoxic response and alteration of intracellular redox balance in Hep-2 cell line by exposure to Iprodione

G. Chaufan, University of Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN); C. Galvano, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica; M.D. Mudry, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Ecología Genética y Evolución

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 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 cells were cultured in a minimal essential medium supplemented with 10% fetal bovine serum (v/v), penicillin (100 mg/ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment. with 5% CO<sub>2</sub> (v/v), at 37 °C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein damage in Petri dishes (7.5×10<sup>3</sup> cells) and for genotoxicity parameters in Petri dishes. From the MTT assays, the LC50 was determined (29.88 (25.99-34.37) 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 micronucleus 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. 

**TU426**

Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826): laboratory and field investigations

T. Campani, I. Caliani, C. Pozzolani, L. Poggioni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Casini, 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% CO<sub>2</sub> (v/v), at 37 °C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein damage in Petri dishes (7.5×10<sup>3</sup> cells) and for genotoxicity parameters in Petri dishes. From the MTT assays, the LC50 was determined (29.88 (25.99-34.37) 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 micronucleus 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 Silversidens, Menidia beryllina
E.N. Velbrusky, 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

Dichloran 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 reported half-lives in seawater and freshwater. While the rate of degradation and C14-labelling of dichloran is impacted by the water Biogeochemistry (3.75 hours), the distribution of intermediate products is altered significantly; 2-chloro-1,4-benzoquinone forms at nearly double the concentration in seawater as compared to freshwater. Chlorothalonil quickly degrades to 4-hydroxychlorothalonil via soil degradation and hydroxylchlorothalonil can desorb back into the water column where it can be photodechlorinated and soil degradation rate and half-life of hydroxylchlorothalonil is very short, but differs significantly between freshwater (32.5 min.) and seawater (301 min.). Both dichloran and chlorothalonil have similar proposed photodegradation pathways, therefore the potential for enhanced phototoxicity due to salinity variation is possible. Dichloran has shown to be phototoxic to inland silversides 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 impacts 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 consequences for aquatic ecosystems. The isoclonal population of Daphnia magna (clone k6) was exposed to an environmentally relevant concentration (5 μg/L) of carbendazim during a certain period of a generation. The effects of carbendazim on survival, growth, reproduction, parental length, DNA damage (determined by comet assay), biochemical biomarkers (cholinesterase, 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. Cholinesterases 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.

Priority & 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 organic chemicals and their ability to predict ionisable chemical 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 where carbendazim was considered as the anion of sorption to 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/EFPIA Innovative Medicines Initiative Joint Undertaking (iPIE 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. Minerio, University of Torino / Chemistry

Sunlight illumination of surface waters induces several photochemical reactions that play an important role in the transformation of dissolved organic matter and xenobiotics, in the inactivation of pathogens and in biogeochemical cycles. These processes involve both the direct photolysis of the target molecules (directly triggered by absorption of sunlight, if any), and their indirect or sensitised phototransformation. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrates) that produce several different reactive species involved in the sensitised phototransformation reactions. The transients include, among others, the hydroxyl (OH) and carbonate (CO32-) radicals, singlet oxygen (1O2) and CDOM triplet states (3CDOM*). 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 freshwater, but its effects could be very different in boreal vs. temperate environments. In the former case the main effects would involve water warming (browning), while in the latter case a role of photoreactive (e.g. warming, treeline shifts, extended drought periods) would play key roles depending on the context. [1] Vione D, Minella M, Maurino V, Minerio C. 2014. Chemistry Eur. J. 20:10590-10606. [2] Rosario-Ortiz FL, Canonica S. 2016. Environ. Sci. Technol. 50:12532-12547. [3] Avetta P, Fabбри D, Minella M, Brigante M, Maurino V, Minerio C, Puzzi M, Vione D. 2016. Water Res. 105:383-394 [4] Minelli L, Leoni B, Salmaso N, Savoie L, Sommaruga R, Vione D. 2016. Sci. Total. Environ. 541:247-256.

WE003
How Pharmaceutical Industrial waste can make your medicines ineffective
N. Verma, Baddd University of Emerging Sciences & Technology / Pharmacy

Spread over 380 square kilometres in Himachal Pradesh’s Solan district, the Baddd-Barotiwala-Nallagarh (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 pollutants is a concern about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipelines 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 the BBN region is considered to be one of the most polluted in India. Many companies manufacture formulations, or finished products such as tablets and syrups. Some companies also manufacture active pharmaceutical ingredients (APIs) or the main biologically active ingredient used in formulations, including antibiotics. These APIs can enter the environment due to insufficient treatment or improper disposal of waste and weak environmental regulations. They are among environmental persistent pharmaceutical pollutants which have not degraded completely during treatment. They may influence the genetic makeup of bacteria, leading to the survival of resistant bacteria and spread of antimicrobial resistance (AMR), a public health threat. The result of our study showed that all gaps leading to the release of
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 implement environmentally sound wastewater 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 area 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; M. Kondo, Tokyo Metropolitan Institute of Public Health / Division of Environmental Health

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 AMEDE’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 (455ng/L), ibandronate (119ng/L), losartan (117ng/L), torasemide (462ng/L) for antihypertensive agents, and sulpiride (545ng/L) for antipsychotic agents, citalopram (445ng/L) for antidepressant drugs, bezafibrate (200ng/L) for hyperlipidemia treatment drug, crotamiton (845ng/L) for antipruritic agents. Among target ingredients, the detect concentration of active ingredient contains pharmaceuticals for the lifestyle-related disease, hypertension and lipid metabolism related disease, tended to be higher. The concentrations in the winter or spring was observed a higher tendency, but the detected concentrations of active ingredients greatly varied depend on river according to the type of lifestyle and the type of pharmaceuticals been spread. It was indicated that the detected active ingredients were derived mainly from sewage treatment water as it depends on the concentrations of sucrose measured at the same time. The pharmaceuticals whose maximum concentration of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candeosartan, olmesartan, losartan, rosuvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider in addition to dilution ratio in the environment which affects whether APIs or active pharmaceutical ingredients by interpreting the environmental health due to the possibility of the presence of highly susceptible species.

Regard the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorazepam to 0.00001% of clofibrate acid.

**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 followed 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 are preferred to sewage treatment water as it depends on the concentrations of sucrose measured at the same time. The pharmaceuticals whose maximum concentration of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candeosartan, olmesartan, lorazepam, rosuvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider in addition to dilution ratio in the environment which affects whether APIs or active pharmaceutical ingredients by interpreting the environmental health due to the possibility of the presence of highly susceptible species.

Regard the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorazepam to 0.00001% of clofibrate acid.

**WE006**
The role of the water-sediment simulation test and its outcome in the environmental risk assessment (ERA) of pharmaceuticals

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In view of the revision of the “Guideline on the environmental risk assessment of medicinal products for human use” (EMEA/CHMP/SWP/4447/00, 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 method 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 persistence of pharmaceuticals in the environment in the next 10 years. 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 filtration will be estimated by that using practice-chemicals e. g. lipophilicity / hydrophilicily by comparing 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 ground water contamination. The identification strategy of relevant TP is still often missing in provided 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 waiting 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. Nellis, SimOmics; S. Owen, AstraZeneca / Safety Health Environment; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; J. Timmis, SimOmics; 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 and/or for optimising and/or simplifying the most expensive API quantification. Predictive models are not without limitations and their assumptions and defaults are, at times, not representative of actual environmental conditions.

Here we evaluate the accuracy of simple exposure models used to generate predicted environmental API concentrations (PECs) and their suitability for prioritisation of APIs in the aquatic environment. Water samples (n=60) were collected in triplicate from six-months both upstream and downstream from five wastewater treatment plants (WWTPs) discharging into four rivers in the UK. Measured environmental concentrations (MEC-values) of 33 APIs were determined by HPLC-MS/MS. PEC-values were determined using pharmaceutical use data from the National Health Service, the fractions of chemical excreted from the body and degraded during sewage treatment, the population served by each WWTP, mean regional per-capita water use and the dilution ratio of treated sewage effluent in receiving rivers. API-specific PEC ranges were compared to complementary MEC ranges observed over the 6-month sampling campaign and PEC:MEC ratios were determined. PEC:MEC ratios were generally low (< 0.5), indicating that predicted API concentrations were lower than measured. Between rivers, PEC:MEC ratios were generally closest to measured values in the lowest flow (smallest) rivers and in stretches near the headwaters indicating that locations with minimal upstream contributions of sewage effluent produced the most accurate PECs. In terms of prioritisation, predicted concentrations successfully identified eight of the ten APIs measured at highest concentrations across two WWTP study locations (metformin, gabapentin, atenolol, desvenlafaxine, fevoxodone, diphenylhydantoin 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.
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 cyclooxygenase (COX) activity in healthy fish tissue 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-exposed to diclofenac – to predict the potential toxicity 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 –

Lethal exposure of non-target organisms is rarely covered in the assessment of chemicals. Especially pharmaceuticals play an important role when it comes to long-term exposure. They enter the environment throughout the year and therefore pose a continuous risk to organisms. One of these ubiquitously detected pharmaceuticals is the antiepileptic drug carbamazepine (CBZ). Hardly degraded during conventional wastewater treatment, it contaminates a majority of wastewater effluents as well as discharge water. A similar approach was used for measured and predicted river concentrations of NSAIDs, which were used to predict plasma concentrations of NSAIDs in wild fish. The overlay of the two approaches led to a visual model that enables a rapid assessment of the risk posed by environmental levels of NSAIDs to trigger multi-scale adverse effects. The major strength of the model is the ability to express the potential toxicity 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.

Effects of duloxetine and econazole on freshwater species towards individual and combined conditions  

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Thousand of biologically active pharmaceutical ingredients (APIs) are used in human and veterinary medicine worldwide. 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 an type of drugs interactions were determined using the Combination Index-isobologram method.

The enantiomers concentration of the target compounds in the culture media were measured by University of Alcalá. Combination Indices: A review on the environmental occurrence and fate processes. Wat. Res. 124: 527—54 Acknowledgement - The research was co-funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMTAVARES and grants CCG2016/EXP-037 by University of Alcalá.

WE011 Application of newly developed in vitro assay to detect physiological activities of antidepressants in wastewater  

M. Ibára, M.O. Ibára, D. Kato, H. ZHANG, Kyoto University –

Over recent years, growing numbers of human pharmaceuticals have been detected in wastewater treatment plant (WWTP) effluents. Concerns about their potential risks to aquatic species has been raised because they are designed to be biologically active. One of most concerned pharmaceuticals are antidepressants. For example, selective serotonin reuptake inhibitors (SSRIs) such as fluoxetine and sertraline could alter the behaviour of fish in vivo testing. Antidepressants such as SSRI, serotonin-norepinephrine reuptake inhibitors (SNRIs), dopamine reuptake inhibitors (DRIs), and tricyclic antidepressants (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 waters. 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 in aquatic environments alter the function of critical non-teratogenic organism, we must know the extent to which such chemicals may be exposed to antidepressants as determined by the inhibition of monoamine transporters. In this study, we measured the physiological activity of antidepressants in WWTP 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), norepinephrine transporter (NET), and 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 succeeded 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 DRIs 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.

WE012 Toxicology of pharmaceuticals to aquatic organisms: a meta-analysis of effects on development and reproduction  

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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 question that has been raised is to improve current understanding of the ecological risks of pharmaceutical compounds to non-target organisms in the environment. 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 among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited the quantitative analysis, however 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. Ungurugyvay, Shantou University / Marine Biology Institute; J. Gan, University of California, Riverside / 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 can be used to predict the potential effect of chiral pharmaceuticals. In this study, we estimated the stereoselective toxicity 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 propanolol, salbutamol, fluoxetine 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 for predicting stereoselective toxicity of chiral pharmaceuticals.

WE014 Effects of benzoylcegonine exposure at different levels of the biological hierarchy on Daphnia magna
M. Parolini, University of Milan / Department of Environmental Science and Policy; B. De Felice, Università degli Studi di Milano; C. Ferrario, University of Milano Bicocca; N. Salgueiro-Gonzalez, IRCCS Istituto di Ricerche Farmacologiche Mario Negri; S. Castiglioni, Mario Negri Institute / Environmental Health Sciences; P. Tromolada, University of Milano / Dept of Biomolecular Sciences and Biotechnology; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences
A number of monitoring studies have shown that benzoylcegonine (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. Few studies that 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 different concentrations of BE, since 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 behavior and the reproduction of Daphnia magna individuals.

WE015 Impact of the antidepressive 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; L. Kundy, M. Biecker, University of Tübingen/ R. Triebkorn, University of Tübingen / Animal Physiological Ecology; L. Kundy, M. Biecker, 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 antidepressive 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 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 (hsp70), 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 Wassernetzwerk Baden-Württemberg Baden-Württemberg Wassen GmbH. Metformin and guanylurea from embryo through 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; The studies have demonstrated that the type 2 diabetic drug metformin and its only 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 its metabolite guanylurea on F1 progeny 28 days post hatch. Metformin and guanylurea concentrations in surface waters. However, possibly 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 reported in order to assess 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; 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
guanylurea during the waste water treatment process, it is found in the environment in higher concentrations than metformin, usually in the µg/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 guanylurea (1.0-100 µg/L) from embryo through 28 days post hatch have a significant decrease in length (mm) and weight (mg) of both males and females when compared to control fish, with guanylurea appearing to be roughly 1,000 times more potent than its metformin counterpart. Furthermore, these studies show significant changes in the metabolism of 28 day old male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. These results raise 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 Guanlyurea J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health Protection; A. Haener, F. Hoffmann-La Roche Ltd / Group SHE (LSO) An Environmental Risk Assessment (ERA) was performed for the active pharmaceutical ingredient mycophenolic acid (MPA) for Europe. MPA is an older immune inhibitor developed in the USA in the 1990s by Syntax, 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 Syntax and on 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. An Environmental Risk Assessment (PNEC) for Europe was derived by dividing the PECs by the PNEC. Potential risk from MPA was also assessed for the USA and EU. A predicted no effect concentration (PNEC) for MPA was derived by standard ERA assumptions of 6 and 10, respectively, for the USA and EU. The PEC/PNEC and MEC/PNEC risk characterization ratios for MPA were also 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 detected in freshwater worldwide. Selective serotonin reuptake inhibitors (SSRIs) are commonly the first-line antidepressant drugs prescribed to alleviate anxiety disorders in humans, and fluoxetine (FLX), the active principle of the Prozac®, is one of the most commonly used worldwide. At FLX enters the aquatic ecosystems, whereby it has been detected in the high ng/L to low µg/L concentration range. Although many studies have demonstrated that the exposure to FLX caused a plethora of adverse effects in aquatic species, the information regarding its molecular mechanisms of action and the relationship with organism behavior remains scant. Thus, the present study was aimed at investigating 1) the effects induced by FLX at environmentally relevant concentrations of 1.0 and 50 µg/L and 2) the expression of genes related to oxidative stress response (sod1, sod2, cat, gxs, and ggt), stress and anxiety (olf, prl2, npy and ucn3), as well as transporters of main neurotransmitters (scl6a3, scl6a4a, scl6a4b, scl6a11) and 2) if changes in the expression of neurotoxicity-related genes was related to changes in the swimming behavior of zebrafish (Danio rerio) embryos at 96 hours post fertilization (hpf). Our results showed that FLX exposure overexpressed sod1, cat and gxs, suggesting that this drug can induce an overproduction of pro-oxidant molecules. In addition, changes in the expression of scl6a4a, scl6a4b, scl6a11 genes indicated that FLX can affect neurotransmission and, consequently, alter swimming behavior of embryos, as demonstrated by the significant reduction of the distance moved by treated embryos in response to an external stimulus.
After use, pharmaceuticals and their residues eventually end up in the sewage system. Sewage treatment plants reduce the nutrient load of wastewater, and while organic micropollutant removal occurs concomitantly by bacterial activity and sorption to many contaminants, including pharmaceuticals, by particulate matter, not all compounds are removed efficiently. Consequently, effluent containing pharmaceuticals and their residues is discharged into surface waters. A recent study showed that 29 of 80 monitored pharmaceuticals were regularly detected in Dutch surface water, and that five of these substances, i.e. the pain killer diclofenac, the antibiotics azithromycin, clarithromycin and sulfamethoxazole, all part of the antiepileptic medication, pose a risk to the aquatic ecosystem (Moermond et al., 2016). This raises concern, perhaps even more so when considering that for many of the around 2000 pharmaceuticals that were authorized for the Dutch market in 2016, it remains unknown to what extent they are present in surface waters, how they behave in the environment, and to what extent they exert toxicity to aquatic species individually and jointly. A class of pharmaceuticals that has received increased attention in the Netherlands, but also in the EU, e.g. PHARMAS project and Cytotherapie, are cytostatics. These potent substances are used to inhibit cell division in cancer patients, but the fraction released unchanged to surface water could affect aquatic species in a similar manner. This project aimed to provide an overview of the use of cytostatics in the Netherlands and to determine if cytostatics pose a potential risk to the aquatic ecosystem. The predominant part of the used substances is expected to enter the environment in the excreta of cancer patients. For an inventory the use of cytostatics was compiled by taking into account the metabolic transformation of cytostatics in patients, the removal efficiency in sewage treatment 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 potential risk to the aquatic environment.

Environmental risk assessment of human pharmaceuticals - what can we learn from regulatory effect data so far? S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; J. Bachmann, German Environment Agency (UBA) / Section IV 2.2 Environmental Risk Assessment of Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals

Simplifying the coming into force of the guideline on the environmental risk assessment of medicinal products for human use (EMEA/CHMP/SWP/4447/00 corr 2), the German Environment Agency (UBA) is tasked with environmental risk assessment of human pharmaceuticals. Applicants seeking approval of medicinal products need to submit fate and effect data, in case predicted environmental concentrations exceed 10 ng/L in surfacewaters, or the substance is of specific concern through its mode of action. For an inventory the use of cytostatics was compiled by taking into account the metabolic transformation of cytostatics in patients, the removal efficiency in sewage treatment 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 potential risk to the aquatic environment.

Environmental risk assessment of human pharmaceuticals; I. Ebert, German Environment Agency

Environmental risk assessment of human pharmaceuticals: More than 12% of evaluated APIs show NOECs below 1 µg/L; with substances with NOECs between 0.01 and 1 µg/L is non-endocrine, belonging to a diverse range of pharmaceutical classes. For approximately 2/3 of investigated APIs, valid effect studies on all three trophic levels were available – allowing a comparison of sensitivity. In over 60 % of cases, the effect value of most and least sensitive test organism was greater than 10, in over 20 % of cases greater than 100. Fish were the most sensitive test organisms in more than half of the cases, while algae and crustaceans were the most sensitive in one quarter, each. Detailed information concerning specific pharmaceuticals (mode of action, monitoring data, available data on fate and effects in the environment) is provided to applicants. The proposed tiered prioritization approach considers also elements of the EMA Guideline for environmental risk assessment of human pharmaceuticals. It is important to recognise that any approach needs to be flexible to ensure successful prioritization and should be regularly adapted to the current state of knowledge.

SETAC Pharmaceuticals Interest Group

G. Maack, German Environment Agency / Ecotoxicological 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 animal species, may trigger the need for full hazard assessment. Several NOECs in the low µg/L-range, particularly for substances with endocrine mode of action. The predominant part of substances with NOECs between 0.01 and 1 µg/L is non-endocrine, belonging to a diverse range of pharmaceutical classes. For approximately 2/3 of investigated APIs, valid effect studies on all three trophic levels were available – allowing a comparison of sensitivity. In over 60 % of cases, the effect value of most and least sensitive test organism was greater than 10, in over 20 % of cases greater than 100. Fish were the most sensitive test organisms in more than half of the cases, while algae and crustaceans were the most sensitive in one quarter, each. Detailed information concerning specific pharmaceuticals (mode of action, monitoring data, available data on fate and effects in the environment) is provided to applicants. The proposed tiered prioritization approach considers also elements of the EMA Guideline for environmental risk assessment of human pharmaceuticals. It is important to recognise that any approach needs to be flexible to ensure successful prioritization and should be regularly adapted to the current state of knowledge.
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 (*Oncorhyncus mykiss*).

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Fish can be exposed to nutritional and chemical stress. In aquaculture, fish oil is increasingly replaced by plant-derived oils, which results in a modification of the fatty acid (FA) composition of the diet. Also, pollutants such as methylmercury (MeHg) are still present in aquatic environments. Adipose tissue is an essential endocrine organ involved in energy homeostasis and can be affected by some stressors. However, there is a lack of knowledge about the effects of FA and MeHg on rainbow trout adipose tissue. In this context, in *in vivo* experiment was conducted and linoleic acid (LA) induced a lipid content increase in fish, while MeHg decreased it. To understand better these results, two *in vitro* experiments were carried out on trout primary cultured adipocytes to study the effects of FA and those of MeHg. *Effects of FAs* - During 2 days, differentiation of confluent cells was induced through a hormonal cocktail. Cells were then incubated during 13 days with 0, 75, 150, 300 and 600 µM of α-linolenic (ALA), eicosapentaenoic, docosahexaenoic (DHA), LA, arachidonic and docosapentaenoic (DPA) acids and 2 µL/mL lipid mixture. At day 13, for each FA, the higher the concentration, the more the lipid accumulation. At 600 mM, DHA and DPA were the most adipogenic FA, while LA and ALA (typical to plant-derived oils) 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 µL/mL 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 increasing MeHg concentrations tended to affect cell morphology, towards a more typical adipocyte phenotype. In contrast, FA incubation of cells 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 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

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The term obesogen 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, paints, plastics, food cans and pesticide-treated food, among others. A growing body of evidences 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 some environmental chemicals are able to alter lipid homeostasis, impacting weight, lipid profile, signaling pathways and/or protein activity, of several lineages of aquatic animals. Such phenomenon can give rise to physiological disorders and disease. Although largely unexplored from a comparative perspective, the key molecular components implicated in lipid homeostasis have likely appeared early in animal evolution. Therefore, it is not surprising that the obesogen effects are found in other animal groups beyond mammals. Collective data indicates that suspected obesogens impact lipid metabolism across phyla that have diverged over 600 million years ago. Here we identify the knowledge gaps in this field and we set future research priorities.

**WE030** The Environmental Causes of Obesity: Novel human in vitro models of adipocyte differentiation for studying the effects of chemical exposure

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Obesity has become a worldwide challenge, with obesity rates not only increasing in adults, but also in children. Obesity is caused by an imbalance between caloric intake and energy expenditure. However, increased caloric intake due to changes in diet and lack of physical activity cannot solely explain the observed rise in obesity. Other factors, such as genetics or environmental stressors, also play a role. Exposure to endocrine disrupting chemicals (EDCs), which act as so-called obesogens during development, may impact on adipogenesis and susceptibility to obesity, and several such compounds have been found to stimulate adipocyte differentiation *in vitro* and *in vivo*. Recent systematic reviews in our group have shown that prenatal exposure to EDCs such as BPA and DEHP is related to increases in adiposity later in life in rodent models. To identify potential obesogens and study the effects of EDCs, several approaches are required. Standard assay systems to screen for obesogens in *in vitro* are either using reporter gene assays e.g. for activation of the peroxisome proliferator-activated receptor gamma (PPARgamma), a key regulator of adipogenesis; or differentiation assays using established cell lines such as 3T3-L1 preadipocytes. However, whereas these assay systems are good screening tools, they only assess effects of obesogens on specific receptor activation or differentiation of already committed, white-type adipocytes. Our research aims at unravelling the effects of obesogenic EDCs on human adipocyte development. The most critical effects of exposure to obesogens are elicited *in utero* and in early life. Therefore, *in vitro* models that mimic the earliest stage of adipogenesis are best suited to investigate how EDCs can disrupt normal cell differentiation during development. One promising cell culture model involves the use of mesenchymal stem cells (MSCs) that can be employed as model for adipogenesis. We also envisage to employ the model to gain an understanding of other processes such as the more recently described “browning” of white adipocytes and the differentiation of MSCs to brown adipocytes.

**WE031** Comparing metabolomic responses in Oryzias latipes to environmentally relevant concentrations of metformin and its metabolite, guanylurea

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In recent years, the occurrence and fate of pharmaceuticals in the aquatic environment has gained increasing attention. 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 metabolite guanylurea in developing fish, we found a significant decrease in length (~6%; mm) and wet weight (~22%; mg) of male Japanese medaka (*Oryzias latipes*) when exposed to 3.2 µg/L metformin from embryo through 28 days 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.

**WE032** Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopecten ventricosus (Sowerby, 1842), exposed to toxic metals

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The digestive gland of bivalves is an essential organ involved in energy homeostasis and can be affected by some environmental stressors. However, there is a lack of knowledge about the effects of obesogenic EDCs on human adipocyte development. The most critical effects of exposure to obesogens are elicited *in utero* and in early life. Therefore, *in vitro* models that mimic the earliest stage of adipogenesis are best suited to investigate how EDCs can disrupt normal cell differentiation during development. One promising cell culture model involves the use of mesenchymal stem cells (MSCs) that can be employed as model for adipogenesis. We also envisage to employ the model to gain an understanding of other processes such as the more recently described “browning” of white adipocytes and the differentiation of MSCs to brown adipocytes.
respectively) and of the mixtures in proportion 1:1. The levels of proteins (Lowry, 1951), carbohydrates (Dubois, 1956), lipids (Bilgh and Dyer, 1959) and cholesterol (Kit Biorad) were quantified at 24, 96, 144 and 168 hours after the start of the bioassay. The Kruskal-Wallis test showed that the difference between the concentrations of proteins, lipids, cholesterol and carbohydrates of the control group compared to the treated samples was significant (p < 0.034). An increase in cholesterol levels was observed at 24 hours of exposure and a decrease in the concentration of proteins, 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)

WE033 Environmental assessment of foaming agent persistence in conditioned soil for EPB-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 mixed into 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-reuse of the excavation products strongly depend on the additive composition, on soil properties and environmental conditions. Concerning the threshold limits in European legislation for these components or 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 ASE 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 higher persistence of the product can be ascribed to the detrimental effect of the additive on the microbial abundance and activity.

WE034 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 its advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher tunnelling speed. The performance of TBMs relies on the use of appropriate soil conditioning foams. The main objective of this research was to determine the fate of anionic 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 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 thresholds present 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 carried out to evaluate the potential impact of spill materials the bacterium Vibrio fischeri showed to 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.

WE035 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 (P1, 28 mg/kg SLES concentration) or P2 (83 mg/kg SLES concentration). 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 ASE 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 higher persistence of the product can be ascribed to the detrimental effect of the additive on the microbial abundance and activity.

WE036 Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line

Thanks to the development of new foaming agents carried out by the R&D Group, MAPEI have created the new product line Polyfoamer ECO with the main goal to reduce the environmental impact on the tunnel muck, thus facilitating the re-use of the tunnel muck as by-products, in example for road constructions or old quarries refilling. All the new Polyfoamer ECO foam agents have been classified by a third-party as environmentally friendly on the basis of the lowest class of risk agents waters and organisms associated to a chemical product, according to the German regulation. The new products Polyfoamer ECO/100 and Polyfoamer ECO/100 Plus are characterized by lower values of COD at the initial 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.
geochemical 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 13148:2:2007) and the fish embryo Dermatopterus Preciosus (Vences) have been carried out. The environmental formulations with the new foaming agents Polyfoamer ECO confirm that these 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, fasta degradation 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.

**WE037**

**Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) following the modified Methylen Blue Active Substances (MBAS) method in soil 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 mechanized tunnelling industry by the use of Tunnel Boring Machines (TBMs). Polymeric foams, Polyfoam (TBM) showed significant contribution of appropriate soil conditioning products, principally 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.

**WE038**

**Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study for EPB-TBM 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 particularly sodium lauryl ether sulphate (SLES) are key 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-silty-sand 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. Sixteen mesocosms 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.

**WE039**

**Preliminary environmental risk assessment of sodium lauryl ether sulphate contained in foaming agents used in mechanized tunnelling**


Anionic surfactants (ANS) are a heterogeneous group of amphipathic compounds characterized by linear aliphatic chains (ranging from C8 to C18) with a polar group (sulphate or sulfonate) neutralized with a counter ion. Given the variability of their molecular composition ANS are considered mixtures. They are utilized in several applications (i.e. detergents, cleaning products, fracking or soil conditioning in the excavation industry). 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 concern 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 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.

**WE040**

**Ecotoxicological assessment of spoil material produced in mechanized tunnelling**


Mechanized excavations using Tunnel Boring Machines (TBM) has consolidated in recent years. In order to facilitate the overall process, specific foaming agents and polymers are added to soil. The main component of many commercial foaming
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 biotests. For this purpose, a soil from a site of sampling, containing two soils with different geopedological characteristics, conditioned with two foaming agents at the same treatment ratios (TR, L/m³) 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 eluate 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 extrem. Commonly accepted standards were tested. The ecotoxicology 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** Expeditous test for on-site monitoring activity in mechanized tunneling applications


In the vast majority of tunnel projects performed with TBM-EPB 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 industrial additives. In order to plan strategies for the spoil disposal management in a virtuous cycle of reuse of the resources leads 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 end of operation. Commonly accepted standards have been developed 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 microorganisms 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 must 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, it seems to be particularly suitable for monitoring large volumes, as those 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 some additive used in mechanized tunneling: effects on daphnids, algae and cress.

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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 toxicity of these active mixtures is not yet fully known as well as the potential effects arising 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/vPB & 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

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Bioaccumulation and trophic transfer of 13 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 (LogBFAwere 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

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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 bioconcentration studies are time consuming, expensive and they use a considerable number of fish. Therefore 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 extrapolated BCF values from freshwater 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 20 000), (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 since Hyalella as an aquatic invertebrate can be quite sensitive. The results from SETAC Europe 28th Annual Meeting Abstract Book
Bioaccumulation of ionizable organic chemicals in fish - The quest for reliable predictors

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Dietary 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 BCF prediction 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 data set 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 acylglycerol units, 7 perfluorinated carboxylic acids, and 8 perfluorooctanoic acid congeners. A parallel data set 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 log Kow was not a sufficient predictor of BMF, although with significant positive correlation (R^2 = 0.40), and b that significant correlation was shown only with logP at pH 3 (R^2 = 0.35). Furthermore, significant negative correlation was shown between BCF and solubility (R < -0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., log Kow) are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BCF from quantum-chemistry-based estimations of partitioning coefficients and parameters representing fish lipoprotein albumin (LpA). 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 radiolabelled test chemicals.

WE046 Evaluation of a tiered approach for the bioaccumulation assessment of fragrance substances: in silico, in vitro assays, invertebrate vs. in vivo fish bioconcentration test

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Bioaccumulation in fish 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 partition 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 tetranorlabdane 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 R^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 factor, which ranged from ~1000 to ~4500, not exceeding the EU criteria for (very) Bioaccumulative substances (vB). 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 hypotrophy 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.

WE047 Proposal for a freshwater trophic magnification study based on a Comprehensive literature evaluation


The 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 factors of a compound from the food web. The TMF can be used to answer different questions in regulatory and monitoring affairs. The TMF can be used in the evaluation of the biomagnification potential of chemicals under REACH. However, TMF may be also applied in the context of the Water Framework Directive to normalize chemical monitoring data of fish to a common trophic level as well as to derive environmental quality standards for the protection goal aquatic ecosystems. To improve the current understanding of TMF, several experimental studies using radiolabeled chemicals and/or appropriate feeding experiments will be conducted. The aim of the study is to define a sound concept for TMF investigations to enhance 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 field 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 spring/summer 2018. The trophic levels of the species will be determined applying different methods such as comparison of stable isotope ratios in the case of different sources of carbon, and stable isotope analysis of amino acids. Sample handling will follow the protocols applied by the German Environmental Specimen Bank (ESB) including cryo-milling, homogenization, sub-sampling, and long-term storage. During all processing steps samples will be kept constantly at a temperature < -150°C. The sample material obtained will be analyzed to derive TMF estimates for different compounds in a food web. Relevant TMF can only be derived from appropriate benchmarking-, and statistical methods will be applied. The validated concept may provide the framework for a new TMF testing scheme integrated in the German Environmental Specimen Bank (ESB).

WE048 Obstacles in identifying PBT/vPvB-substances under REACH for high tonnage chemicals

A. Oertel, J. Menz, A.L. Krongsbein, K. Maul, A. Brüening, A. Schulte, German Federal Institute for Risk Assessment / Chemicals and Product Safety Appropriate ecotoxicological and toxicological information provided by registrants is crucial for identifying substances with PBT/vPvB properties under REACH (Regulation (EC) No 1907/2006. Registration, Evaluation, Authorisation and Restriction of Chemicals). The availability of that information in REACH registration dossiers of substances manufactured or imported in quantities of 100 to 1000 tons per year (tpa) is evaluatable in the current project on REACH compliance. This is a follow-up project on substances registered in quantities of 1000 tpa or more, related to human health, the environment, ecotoxicology and ecotoxicity. Developmental and reproductive toxicity and the magnetic activity are considered and for the environment the magnetic activity is included. In previous years stable isotope analysis of different amino acids). Sample handling will follow the protocols applied by the German Environmental Specimen Bank (ESB) including cryo-milling, homogenization, sub-sampling, and long-term storage. During all processing steps samples will be kept constantly at a temperature < -150°C. The sample material obtained will be analyzed to derive TMF estimates for different compounds in a food web. Relevant TMF can only be derived from appropriate benchmarking-, and statistical methods will be applied. The validated concept may provide the framework for a new TMF testing scheme integrated in the German Environmental Specimen Bank (ESB).

BCFS 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 hypotrophy 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.
WE049
PBT/vPvBs: All equally bad or worse than others? - How to inform risk management
K. Theile, WUR; S. Gabbert, Wageningen University / Social Sciences
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 inherent 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 hazard 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 Esters (OPEs)
T.T. 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, a polymeric class of compounds, the usage of which 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 (PMOCs). We modified the Multimedia Urban Model (MUM) of Diamond and co-workers by using a pool-LEF/EFER model to represent partitioning, and modified the wet deposition processes to account for intermittent rainfall. We looked at three chlorinated (CI-OPEs) and three non-chlorinated OPEs (non-CI-OPEs) in Toronto, Canada. Our goal was to estimate their emissions to Toronto air and to evaluate their environmental pathways. Air emissions were estimated by from measured outdoor air concentrations and model results were evaluated against measured water and rain concentrations in Toronto tributaries. Based on estimated emissions to air, modulated water and rain concentrations were within an order of magnitude of the measured concentrations, with an RMSE of 140% of the mean measured water and rain concentration. Since the water and rain concentrations were taken independently of the air concentrations, these results give some credence to the model estimates and showed that the emissions estimates were accurate to approximately an order of magnitude. Estimated aggregate emissions to outdoor Toronto air of OPEs for 2010 ranged from 110 (TDCPP) to 1,200 (TCEP) kg/y and were significantly higher than emissions of ΣPCBs (90 kg/y) and ΣBDEs (9.5 kg/y) for 2008, calculated using the same model. The results show that using modelling techniques developed for polar, hydrophilic compounds can provide estimates of emissions and fate to a similar level of accuracy as was shown for persistent, bioaccumulative polymeric compounds. These model estimates provide evidence of relatively high emission rates to air and, by showing OPE mobility in water, support the hypothesis of long-range transport of CI-OPEs by rivers. The major route of transfer for CI-OPEs to surface waters systems is through stormwater runoff, either through the washoff of films on impervious surfaces or soil wash-off.

WE051
An approach for the evaluation of PBT and vPvB substances subject to authorisation and restriction procedures in the context of socio-economic 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 für Umwelt analyse and restriction processes. Both regulatory instruments make use of socio-economic analysis (SEA), which is generally defined to be a tool for assessing all relevant positive and negative impacts from substances’ use or non-use, and for comparing these impacts across different scenarios. Impacts from chemicals’ use, including PBTs/vPvBs, are subject to a comparative cost-effectiveness analysis (CEA). Furthermore, due to stock pollution properties of PBTs/vPvBs, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBT/vPvB substances, the evaluation of PBT/vPvB substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e. 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 chemicals’ use subject to a comparative cost-effectiveness analysis (CEA). This approach starts with a grouping and ranking of PBT/vPvB substances (stage 1). Following to this, exposure dynamics are analysed with a multimedia stock pollution approach (stage 2). The evaluation of impacts arising from the stock can be evaluated via different routes (stage 3). 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 or multiple uses of a PBT/vPvB substance (stage 4), and to benchmarks, being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared (stage 5). The approach offers a ready-for use framework for a concern-based evaluation of PBT/vPvB substances to be used as decision-support in REACH authorisation and restriction processes.

WE052
Polymers: The Next Frontier in Environmental Hazard Assessment
A. Carrao, Kao USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Coleman II, Kai USA
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, theology 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 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 physicalchemical properties. However, in reality, there is a potential for these materials to cause negative effects, from a concern. Therefore, 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 functions in cosmetic formulations also makes these substances difficult to test in aquatic systems – varying absorption properties, molecular charge, insolubility, etc. Therefore, safety assessors evaluating polymers must look to new and novel approaches for filling environmental data gaps in order to create a robust environmental hazard assessment. This poster will examine the current polymer landscape for cosmetic uses, identify common data gaps, provide possible solutions to fill those data gaps, and offer a prioritization scheme for future testing of polymers. Ultimately, the objective is to suggest a more modern approach to substantiating the environmental safety of the large variety of polymers used in cosmetic and personal care products.

WE053
A consistent Approach for PBT/vPvB Assessment for Pharmaceutical Products
E. Nfon, Smithers Viscenti / Department of Regulatory Affairs; K. Malekani, Smithers Viscenti / Environmental Fate and Metabolism
Keywords: Persistence, bioaccumulation, Toxicity, Pharmaceuticals Track 6: Environmental policy, risk management, and science communication. Session 6.7: PBT/vPvB Assessment: Update on regulatory guidance,
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 criteria 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 not regulated under REACH for pharmaceuticals, which are considered as a different category of chemicals. 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 if it was PBT. Furthermore, additional information on the regulatory consequences of the PBT-assessment for any given product, the situation may change in the future. It is our hope the EMA will issue clear guidance on how a PBT/vPvB assessment should be performed for pharmaceutical products and the consequences for products which fulfil the PBT/vPvB criteria. This presentation will describe our experiences and the challenges we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from CoR (Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE054 Evaluation of new assessment methods and enhancement of PBT/vPvB criteria for ionisable substances
H. Holzmann, RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics
The identification of persistent (P) bioaccumulative (B) and toxic (T) substances under the EU regulation REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) was developed to assess neutral organic compounds. However, nearly 50 % of the chemicals pre-registered at the European Chemicals Agency (ECHA) are partly or completely ionised under environmental conditions (Franco et al., 2010). Since the charge of chemicals strongly influences their properties and environmental behaviour, the currently valid concept under the REACH legislation does not appear to be a sufficient basis for a confident assessment of ionisable substances. The objective of the project is to refine the P assessment of ionic and ionisable substances under REACH. For this purpose, simulation tests following OECD guidelines are conducted using two different types of environmental compartments: Aerobic and Anaerobic Transformation in Aquatic Sediment Systems (OECD 308) and Aerobic Mineralisation in Surface Water (OECD 309). As models substances we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from CoR (Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE055 Assessment of the persistence of ionic or ionisable organic chemicals under REACH
D. Classen, RWTH Aachen University / Institute for Environmental Research; J. Ackermann, Federal Environment Agency Umweltbundesamt / Chemicals; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics
For the protection of humans and the environment, the identification and regulation of chemicals with persistent (P), bioaccumulative (B) and toxic (T) properties are central within the environmental assessment. The criteria for the identification of PBT substances under REACH (Registration, Evaluation and Authorization of Chemicals) (EU Nr. 1907/2006) and the guidance for the PBT-assessment have been developed for neutral organic molecules, and do not properly address charged chemicals. Due to their charge, ion and ionic substances seem to behave differently in the environment compared to neutral substances. With the addition of cationic, anionic or amphoteric characteristics, the chemicals intrinsic properties (e.g. water solubility, log Kow) change as a function of the environmental pH. This dependency affects the distribution of these substances within environmental compartments. The ionic function may also lead to different interactions between organic or mineral solid particles and the substance, influencing their bioavailability for potentially decomposing microorganisms, which are governing biotical degradation. In order to improve the evaluation of the persistence of ionic and ionisable substances in the PBT-assessment, sorption and degradation patterns of charged model substances typically carrying either a positive, negative, or non-charged functional group will be investigated. The sorption behavior of 14C-labeled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonic acid sodium salt and 4-n-Dodecylbenzylethoxymethyllammonium 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 behavior 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 ionisable substances in the PBT-assessment.

WE056 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. Kálai, University of Pécs / Organic and Medicinal Chemistry; M. Mathies, University of Osnabrueck / Institute of Environmental Research
Sulfonamides are used in animal husbandry for treatment of infections. After application of manure of treated livestock to soil, SAAs interact with organic soil components, e.g. by reversible sorption or irreversible formation of non-extractable residues (NER). The latter is attributed to physical entrapment (sequestration) or/and covalent binding to soil organic matter. The paper presents a new approach of using stable paramagnetic spin-labels to investigate the kinetics of covalent bond formation of SAs. The nitroxide spin label 5,5-dimethyl-1-pyrroline-N-oxide (DMPO) is used to determine the first trapping kinetic constant (type 1, heavily sorbed fraction) and type 2 (physically entrapped fraction) are considered. However, distinguishing between these types of NER presents a challenge. In order to improve the evaluation of the persistence of ionic and ionisable substances in the PBT-assessment, sorption and degradation patterns of charged model substances typically carrying either a positive, negative, or non-charged functional group will be investigated. The sorption behavior of 14C-labeled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonic acid sodium salt and 4-n-Dodecylbenzylethoxymethyllammonium 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 behavior 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 ionisable substances in the PBT-assessment.

WE057 The role of non-extractable residues in the environmental risk assessment from regulatory perspective - requirements and challenges
A. Wiemann, UBA Umweltbundesamt; J. Hogebuck, Federal Institute of Hydrology; G. Speichert, German Environment Agency UBA; D. Gildemeister, Umweltbundesamt / German Environment Agency / IV.2.2 Pharmaceuticals; D. Löffler, T. Ternes, German Federal Institute of Hydrology
Non-extractable residues (NER) are found 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, vBp, 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 terms of substance transformation and soil/sediment behaviour. The potential of NER to become irreversibly 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
considered to be possibly remobilised in the environment. NER Type 3 (covalently bound residues) and type 4 (biogenic bound NER) are considered to be irreversible bound to soil/sediment or transformed into biomass and therefore a risk to the environment is not anticipated. Furthermore, a stepwise extraction scheme is proposed which would allow the determination of these different NER types. The comprehensive scientific assessment of this extraction scheme supported by experimental data was the aim of a research project funded by UBA.

Transformation tests in soil with 13C-labelled substances were carried out in accordance with the OECD 307 guideline. Different extraction methods and chemical breakdown procedures were performed and compared in order to characterise the formation of the different NER types. Under consideration of these results, a refined extraction scheme will be proposed with respect to the general applicability for the assessment of NER. In addition, the reversibly bound fractions have to be considered in assessment of the persistence. An UBA evaluation of regulatory data demonstrate the effects of several influencing factors (e.g. extraction methods, soil type) on NER formation.

WE058 Sorption properties of Ionic organic chemicals: Correlations between ion exchange chromatography retention factors and environmental sorption coefficients S. Endo, Osaka City University / Urban Research Plaza & Graduate School of Engineering; L. Henneberger, Helmholtz centre for environmental research - UFZ / Cell Toxicology; K. Goss, Helmholtz centre for environmental research - UFZ / Analytica

A common metric for the extent of equilibrium sorption and partitioning, such as the octanol-water partition coefficient (Kow) for neutral organic chemicals, does not exist for ionic organic chemicals. Finding a suitable reference sorption system for ionic organic chemicals should enhance the evaluation, modeling, and prediction of environmentally-relevant sorption coefficients for such chemicals. In this study, we considered synthetic ion exchange materials as possible reference systems for sorption phases and compared their sorption properties against those of various environmental and biological materials. Retention times on commercial ion exchange chromatography columns were measured in fully aqueous eluent and were converted to retention factors (k'), which are proportional to the ion-exchanger-water partition coefficients. In the end, we established a data set for retention factors of 61 cations on a strong cation exchange column (SCX), 24 cations on a weak cation exchange column (WCX), and 66 anions on a weak anion exchange column (WAX) measured in consistent experimental conditions (i.e., pH, T, co-existing ions, injected amount). The obtained retention factors were compared to soil organic carbon-water (Koc), clay minerals-water (KCM/w), bovine serum albumin-water (KBSA/w), and muscle protein-water partition coefficients (KMP/w) from the literature. Relative good correlations (R² = 0.5-0.6) were found for some cases such as log Koc, log KMP/w, and log KBSA/w against log k' for WAX. For comparison, similar correlation analyses were performed using experimental and predicted log Kow instead of log k'. In most cases, the correlation with log Kow were lower than the correlation with log k'.

Namely, log k' has a clearly larger applicability domain than log Kow, because log Kow is unavailable for ionic chemicals derived from strong acids/bases (e.g., sulfonates, quaternary ammoniums), whereas log k' can be measured for such ions too. This study offers a step forward to the development of accurate prediction models for sorption coefficients of ionic chemicals in the environment.

WE059 Simulation of the fate of co-labeled 13C3-15N-glysophate in a water-sediment system and formation of biogenic non-extractable residues A. Brock, DTU Environment / DTU Environment; A. Rein, Technische Universität München / Chair of Hydrogeology; F. Pollesel, Technical University of Denmark (DTU) / DTU Environment; K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); M. Kästner, Helmholtz Centre for Environmental Research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU Environment

The combination of dynamic simulation and stable isotope techniques allows the tracking of the assimilation of pesticides into biomass [1]. Here, we simulated the fate of co-labeled 13C3-15N-glysophate in an Oxic Sediment Water degradation test [2]. The mathematical model used consisted of two compartments for sediment (slow and rapid ad-/desorption), one compartment for dissolved mass, and microbial growth and metabolism. The flow of both 13C and 15N were balanced. The model considers two biodegradation pathways for glyphosate, namely the saccharine-pathway with complete mineralization, and the incomplete pathway with AOX, non-stable bound with very low degradation rates estimated from the data, while others were calculated. The microbial growth yield was predicted from the MTB method, using thermodynamics and chemical structure [3]. The model can capture the dynamics of the system, including degradation of glyphosate, formation of AMAP and CO2, formation of living and dead biomass (proteins) and chemical adsorption. At the end of the experiment (80 days) non-extractable residues accounted for 23% of the 13C and 26% of the 15N. 10% of the 13C and 12% of the 15N were recovered from the protein fraction (mostly non-living amino acids), which is equal to the biogenic non-extractable residues (NER). Biogenic NER consist of assimilated 15N/15N and are thus considered to be irreversibly bound as proposed in the updated ECHA guideline for PBT/vPvB assessment [4]. This is the first study simulating the formation of biogenic NER using experiments with 15N-labeled molecules. [1] Kästner, M., Nowak, K. M., Milten, A., Trapp, S., & Schäffer, A. (2014). Classification and Modelling of Nonextractable Residue (NER) Formation of Xenobiotics in Soil – A Synthesis. Crit Rev Environ Sci Technol, 44(19), 2107–2171. [2] Wang, S., Seibert, W., Kästner, M., Milten, A., Schäffer, A., Rentschma, T., Q. Yan, Nowak, K. M. (2016). (Bio)degradation pathways in various strongly bound and stable isotope co-labeling approach. Water Res., 99, 91–100. [3] Brock, A. L., Kästner, M., Trapp, S. (2017). Microbial growth yield estimates from thermodynamics and its importance for degradation of pesticides and formation of biogenic non-extractable residues. SAR QSAR Environ Res, 28(8), 629–650. [4] European Chemical Agency (2017). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.11: PBT/vPvB assessment, Helsinki, Finland.
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 xenONER (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-aceic Acid and Natural Montmorillonite Clay Minerals
C. Gu, Nanjing University / School of the Environment; L. Zhang, Nanjing 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 photoionization of this molecule, and inorganic hydrogen, 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, the knowledge of extraneous reactions from laboratory studies exhibited a superiority in the promotion of the degradation rate compared to that saturated with calcium (Ca++)-montmorillonite, and this reaction was conspicuously suppressed as pH increased. In this process, montmorillonite not only increases the yield and prolongs the lifetime of hydrated electrons by stabilizing radical cations through electrostatic attraction with the negative charges embedded in the interlayer, but also provides a confined space where the probability of contact between atrazine and active radicals is markedly increased. In this study, we also investigated the influence of smectite hydration status on the degradation efficiency of atrazine, which revealed that freeze-dried K+montmorillonite promoted the degradation process to a greater extent than freshly-prepared K+montmorillonite, while the freeze drying process had no significant influence on the hydration status of Ca++-montmorillonite.

WE063 Photodegradation Half-lives of a Fragrance Ingredient in Natural Waters at Depth Calculated from Laboratory Study Results
L. Li, Firmenich Research & Development; K. McNeill, ETH Zurich / Institute of Crop and Environmental Chemistry; M. Embberger, A. Casilli, V. Hewins, Firmenich, Inc / Research & Development; S. Gimeno, Firmenich / Product Safety and Regulatory Affairs
Photodegradation, an important abiotic degradation process, is rarely considered in the persistence assessment of chemical substances. This is due to the difficulties and of naturally occurring compounds. The relevant reactions are generally divided into two categories: direct photodegradation and indirect photodegradation. Direct photodegradation is where the substance is directly photolysed and transformed as a consequence of sunlight being absorbed by the substance. Indirect photodegradation involves molecules that absorb sunlight and are transformed as a consequence of the light screening effect of organic matter once the light enters the water column. This research focused on the photolytic fate of fungicides, which account for approximately half of pesticide usage in Europe, in natural waters. For the several commonly used fungicides investigated, the results show that both direct and indirect photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.

WE065 Study Design Considerations for E-Fate Testing of UVCB Substances
C. Lowrie, Charles River / Environmental Fate and Metabolism
Substances of unknown or variable composition, complex reaction products or biotic. In this case, the UVCB data is produced for the exemplar which is not fully identifiable and their composition may be difficult to predict. Under REACH Registration, it may be necessary to test these substances, which from many perspectives represents significant challenges. Reference is made to REACH Regulations and in particular Annex VII Section 9.2 where a series of degradation studies are proposed including simulation testing in surface water, soil and biological materials (UVCB Substances) are products which are often not fully characterized in the four phases 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 photoionization of this molecule, and inorganic hydrogen, 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, the knowledge of extraneous reactions from laboratory studies exhibited a superiority in the promotion of the degradation rate compared to that saturated with calcium (Ca++)-montmorillonite, and this reaction was conspicuously suppressed as pH increased. In this process, montmorillonite not only increases the yield and prolongs the lifetime of hydrated electrons by stabilizing radical cations through electrostatic attraction with the negative charges embedded in the interlayer, but also provides a confined space where the probability of contact between atrazine and active radicals is markedly increased. In this study, we also investigated the influence of smectite hydration status on the degradation efficiency of atrazine, which revealed that freeze-dried K+montmorillonite promoted the degradation process to a greater extent than freshly-prepared K+montmorillonite, while the freeze drying process had no significant influence on the hydration status of Ca++-montmorillonite.

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. Motta, University of Insubria / Department of Theoretical and Applied Sciences DiSTA; A. Sangion, P. Gramatica, 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 two categories: direct photodegradation and indirect photodegradation. Direct photodegradation involves molecules that absorb sunlight and are transformed as a consequence of the light screening effect of organic matter once the light enters the water column. This research focused on the photolytic fate of fungicides, which account for approximately half of pesticide usage in Europe, in natural waters. For the several commonly used fungicides investigated, the results show that both direct and indirect photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.

WE064 The Photolytic Fate of Fungicides
J. Apell, MIT / Civil & Environmental Engineering; K. McNeill, ETH Zurich
The use of pesticides has allowed for increased crop productivity in agriculture. However, because of their frequent application onto agricultural lands, their environmental fate is of particular interest. Pesticides have been ubiquitously detected in natural waters throughout Europe as well as in water supplies, which suggests these pesticides may be more mobile and persistent than their initial evaluations indicated. A potential reason for the mischaracterization of these pesticides' persistence is the lack of environmental fate studies that may help identify reactive intermediates in pathways in the environment. For example, only direct photolysis in pure water can be considered, but the presence of dissolved organic matter can significantly affect the photolytic fate of pesticides in natural water. The photolytic degradation can either be enhanced by indirect photolysis reactions with photochemically produced reactive intermediates (e.g., triplet state dissolved organic matter, single oxygen, hydroxyl radical), or it can be suppressed by the light screening effect of organic matter once the light enters the water column. This research focused on the photolytic fate of fungicides, which account for approximately half of pesticide usage in Europe, in natural waters. For the several commonly used fungicides investigated, the results show that both direct and indirect photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.
descriptors. The choice of phenols is motivated by the fact that they are the most likely compounds to undergo triplet-sensitised phototransformation in sunlight surface waters. Results show that the reaction rate constants with 3AQ2S and 4ICBP give the best QSAR models that can be used to simulate the photodegradation of phenols and similar compounds in the presence of CDOM. Quality differences in the QSARs generated for these reactions are probably due to differences in the chemical structure of the four sensitizers. These results provide additional insight into the mechanisms that regulate the fate of potential organic pollutants in surface waters. They will be used to design future experimental tests by focussing on one/two among the studied sensitizers, and to predict the photodegradation of new and existing substituted phenols and similar compounds on the basis of their chemical structure.

**WE067**

In silico Tools to Assess the Confidence of QSAR Model Predictions

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For the regulatory acceptability of QSAR predictions solid information about the reliability of the applied models is crucial. This regards the model in general as well as the particular prediction for a certain chemical. The presented study provides computerized tools to support the assignment 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 beyond the structural set(s) of the 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 information has been used in silico methods. Ecological Chemical suites, 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.

**WE068**

Data Gap filling with ECOSAR in K-REACH compliance, a limitation and weakness

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ECOSAR is a computer based QSAR program developed by US EPA within the regulatory constraints of the TSCA. However, it is also used in other country or organization such as EU, Korea, OECD, etc. for their regulatory purpose. We introduced ECOSAR program to generate toxicity data and fill the data gap for developing species sensitivity distribution of 20 organic compounds. However, ECOSAR shows more pragmatic than theoretical characteristic. Thus, we investigated whether this model shows acceptable results on the deficient data of 20 organic compounds or not. Therefore we collected published data for fish and daphnia available and compared their geometric value to the output of ECOSAR. Some chemicals show similar output value to experimental data within double scale bars while show very large difference of 1,400 times higher value in ECOSAR output. The least predictable substance is acrylic acid where 4 experimental data are used for the geometric mean value. On the contrary, methyl hydrazine shows almost 10 times output. The least predictable substance is acrylic acid where 4 experimental data are used for the geometric mean value.

**WE069**

Innovative analytical method to enhance POPs and emerging pollutants extraction in water samples by micelles using GC-MS/MS

S. Giannarelli, University of Pisa / Chemistry and Industrial Chemistry; I. De Angelis, A. Lazzarelli, University of Pisa / Department of Chemistry and Industrial Chemistry

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 migrate to hydrophilic micellar core region. This technique was developed as an alternative 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 using the micelles; and b) extraction of analytes from 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 in nonionic surfactants, tail length and pH of the micelles. Once solubilized, the compounds or their equivalent level of concern to persistent, bioaccumulative, toxic chemicals defined in Article 7(1) of REACH 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 information has been used in silico methods. Ecological Chemical suites, 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.

**WE070**

Water Treatment - A Regulatory Challenge under Regulation (EC) No 1107/2009

F. Schnitzler, S. Dorn, J. Wilbuer, Dr Knoell Consult GmbH

Regulation (EC) No 1107/2009 aims to protect humans and the environment and lays down rules for the authorisation of plant protection products in commercial form and for their placing on the market, use and control. Plant protection products consist of or contain active substances, i.e. the molecules or materials responsible for the action against the target pest, weed or fungal. Ozonation and chlorination are primary disinfection processes for central water treatment. Metabolites of certain active substances were found to react during ozonation of drinking water and to form by-products with toxic, carcinogenic and genotoxic characteristics. During the approval process of active substances, data-gaps have recently been identified by EFSA regarding Article 4, 3(b) of Regulation (EC) No 1107/2009: A plant protection product ... shall have no immediate or delayed harmful effect on human health ... directly or through drinking water (taking into account substances resulting from water treatment)... In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidance document for non-risk assessment tail length and pH of the micelles. Once solubilized, the compounds or their equivalent level of concern to persistent, bioaccumulative, toxic (PBT) or a very persistent, very bioaccumulative (vPvB) chemicals. In order to protect human and the environment, additional physico-chemical properties to PBT and vPvB may be relevant to consider. Mobility is one of these additional properties and persistent, mobile, toxic (PMT) chemicals as SVHC based on their equivalent level of concern to persistent, bioaccumulative, toxic chemicals defined in Article 7(1) of REACH are used as alternative materials. An overview of these regulatory challenges is provided with intermediate recommendations to address water treatment processes for active substance approval.

**WE071**

The identification of persistent, mobile, toxic (PMT) chemicals as SVHC based on their equivalent level of concern to persistent, bioaccumulative, toxic chemicals defined in Article 7(1) of REACH

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The identification of polychlorinated biphenyls in top predators nearly 50 years ago led to the establishment of many environmental chemistry regulations and chemical regulatory frameworks directed towards persistent, bioaccumulative, toxic (PBT) or a very persistent, very bioaccumulative (vPvB) chemicals. In order to protect human and the environment, additional physico-chemical properties to PBT and vPvB may be relevant to consider. Mobility is one of these additional properties and persistent, mobile, toxic or very persistent very mobile compounds are an important problem. The chemical properties of these compounds having higher reliability, which may reduce the error of ECOSAR in regulatory area.

**WE439**

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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 assessed whether it should be placed on the candidate list. The most effective management strategy is 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/vPvB substances have been registered under REACH? - vPvM/vPvB 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
UAB, Germany, has initiated work to develop criteria to identify substances which are very persistent and mobile (vPvM) and very mobile and toxic (vPvB). The evaluation of substance specific substance groups of organic substances. For persistency (P) and mobility (vP) algorithms as used for the persistency screening under PBT assessment was used. A new screening algorithm for very persistent substances (vP) was set up by adjusting the P screening algorithm. For mobility (vM) and very mobile (vV) substances new screening algorithms were developed using the substance properties of water solubility (Sw) and the soil/sediment organic carbon-water partition coefficient (log Koc) by log Koc and Sw values based on >64,000 substances. The pH-dependent octanol-water partition coefficient (log Dow) 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 on top 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 per manufacturer or importer. The screenings identify substances according to criteria proposed by UAB and the developed QSAR algorithms were applied on top the screening algorithms for P and M 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, denkares; D. Sätter, UBA / Section IV - Chemicals; I. Schliebner, UBA; M. Neumann, German Environment Agency (UBA) / Section IV - Chemicals
The chemicals that have the greatest chances of appearing in drinking water are those that are mobile in the aquatic environment enough to enter drinking water sources and persistent enough to survive water treatment processes. Despite the large number of substances being released to the market, there has been very little consideration as to how to identify or categorize which of them are persistent, mobile and toxic (PMT) and thereby pose a threat to drinking water. Within the list of REACH registered substances as of May 2017 was independently evaluated for their likelihood of being a PMT. The evaluation of persistent (P), very persistent (vP), or potentially persistent (i.e. Pscreen) was performed according to REACH guidelines. For mobility, a criteria of a measured (or estimated) log Koc six or less fluorinated carbons ("short chain"). 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 very high repellency and critical properties on high-end performance garments, workwear, first responder gear and in many other applications. Within the non-polymeric fluorotelomer-based product categories provide superior surface wetting and leveling properties and are used in many finishes and applications. Fluorotelomer-based 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.

WE075
LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluoralkyl acids in Veneto region (Italy)
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In 2013 a significant episodic contamination of surface and drinking water has been discovered in a large area of the Veneto region, in Northern Italy. The most important source of pollution was identified in a fluorocarbon plant, sited in an area of groundwater recharge. The Veneto Region immediately put in place mitigation actions that were more effective for long chain PFAS than for short chain ones. For that reason, within the framework of the Community Life Program, a LIFE project, named LIFE PHOENIX: a new project for the management of water pollution from short chain perfluoralkyl acids, coordinated by the Department of Health Protection, Food and Veterinary Safety of the 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 put into practice a holistic institutional framework of integrated management system, supported through innovative tools and methodologies, to control risks and manage waste; to involve stakeholders and 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 be tested as a model for managing analogous chemical pollution events from persistent and soluble polar substances.
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 focus 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 Jura Formation, which consists of sandy and silty sediments to silty sands of reddish brown to light brown color, very friable, and with scarce calcareous bodies of pedogenic origin. The Junin Formation of wind morphology constitutes an alternation of low elevations and depressions. Aeolian sediments, which belong to the Junin Formation (Aeolian Platane), 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 their main anionic and cationic constituents, presence of glycolipids and chlorophylls, TOC, arsenic and fluoride. Also, cytology and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Esteria ferox. Water quality was analyzed in combination with the dominant taxon of invertebrates founded. They were mainly epigean Copepods, Acari, Collembola, Insecta, Oligochaeta, Nematomorpha. A preliminary biotic and ecotoxic index were created to characterize each sampling well.

WE079
Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study
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Aqua regia, Ferric chloride, and hydrogen peroxide were used to extract the pigments and compounds of different samples. The flavonoids were quantified by HPLC with diode array detector in the range 235-450 nm. The chlorophylls a and b were extracted from the algae with methanol and quantified by spectrophotometry at 475 and 665 nm. The total phenols were determined by the Folin-Ciocalteu method. The proteins were determined after the trichloroacetic acid precipitation with the Lowry assay. The proline was estimated by the method of Udenfriend and Markert. The total carbohydrates were determined by the phenol-sulfuric acid method. The total nitrogen was determined by the Kjeldahl method. The pigments and compounds were separated by high-performance liquid chromatography (HPLC) with diode-array detector (DAD) at 280 and 350 nm. The extracts were subjected to thin-layer chromatography (TLC) with chloroform-methanol (9:1) and silica gel 60 as a stationary phase. The organic compounds were identified by comparison with authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. The compounds were also identified by comparison of their retention times and UV spectra with those of authentic standards. 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Pharmaceutical residues in sewage effluents pollute 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 parallel ozonation setup. We investigated estrogenic, reproductive 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 ($70 \mu g L^{-1}$). We exposed zebrafish to dechlorinated tap water (n=5), 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 contained more organic and a nitrogen component in the effluent. A second acute toxicity screening revealed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. In order to provide realistic measurements, the study should be conducted in a controlled environment, using similar conditions as those used in the laboratory to ensure reliable results.
weighted, homogenized and centrifuged for the determination of hydroperoxides, lipopolysaccharides, carbonated 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.

**WE086**

An assessment of (anti-)androgenic activity in sludge from a rain spillway basin of the WWTP Aachen Soers as well as in sediments from the catchment area of the recipient water, the river Wurm

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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, mostly 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 sediments in sewage sludge and so these compounds can be even more harmful. To differentiate endocrine-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 and after 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. In an example of such an investigation, to gain more information. Assessment of (anti-) androgenic activity was performed by testing sample extracts using the (anti-)AR-CALUX® assay. These studies will be conducted associated to the DemOAC Project as part of an exploratory study. First results revealed an anti-androgenic potential as well as cytotoxicity in the highest concentrations of the samples. The full depiction of the (anti-) androgenic activity in the catchment area of the Wurm will be available at the time of the conference.

**WE087**

Processes underlying the environmental fate of pharmaceuticals in the Nairobi River Basin “impact zone”: implication for environmental risk assessment

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Recent investigations have highlighted the widely-spread occurrence of active pharmaceutical ingredients (APIs) in African water bodies. Wastewater (treated or otherwise) is the main source of APIs to the environment and identified heavily contaminated areas have been ascribed to the poor African wastewater treatment facilities (WWT). The formation of so called “impact zones” is severe in urban areas characterized by informal settlements with little in the way of wastewater treatment. The Nairobi River (KNR) is an example of such contaminated areas. The wastewater generated from local informal settlements and the insufficient WWT is directly discharged in the Nairobi River basin leading to a large-scale “impact zone” characterized by occurrence of high levels of ammonia, biochemical oxygen demand and low dissolved oxygen and commensurately elevated levels of APIs. Also, the presence in this area of industrial wastewater large areas. The wastewater generated from waste and industrial wastewater together with the local natural sorbents abundance influences the APIs distribution and E-fate. Data will be presented on sorbent concentration and quality related to distribution processes of APIs in the impact zone and the individualization of eventual bacteriological community shifts as an effect of the direct discharge of untreated wastewater loaded with APIs. In addition, since preliminary studies on the biodegradation of the antitryprol nevirapine, commonly used in Africa, has showed persistance (similarly to studies on the antiepileptic carbamazepine in Western countries) the occurrence of nevirapine will be studied to test its suitability as indicator of sewage pollution in African river bodies. The implementation of new fos in 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.

**WE088**

Occurrence of pharmaceuticals, metabolites and transformation products from combined sewer overflows in London measured by high resolution targeted, suspect screening and untargeted chemical analysis

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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, CSO occur ~1 times per week as its Victorian sewer network struggles to cope. Here we present 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 aspects: (a) the identification of CSO markers based on the determination of 30 pharmaceutical/metabolite occurrences in influent and effluent wastewater; (b) determination of CSO markers in receiving river water over a six-week period; (c) suspect screening to identify metabolites/transition products; and (d) classification of samples using untargeted data analysis. By differentiating influent and effluent, CSO markers were identified including caffeine, bezafibrate, benzoylecgonine 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 when the tide was low. A further 14 compounds were also determined to observe any ‘dilution effects’ related to CSO dilution. (c) 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 [1]. 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 and interpretation are necessary for the understanding of complex 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

**WE089**

Occurrence, fate and bioactivity of pesticides in wastewater

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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 (WWTs) is limited. Our research showed that of the 18 compounds investigated only imidacloprid, was not detected at the three WWTs 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 androgenic screen (YAS) assays) the bioactivities of the pesticides as well as wastewater effluents treated using secondary treatment or ozonation was investigated. It was found that of the 12 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 neonicotinoids. 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 androgenic activity during the ozonation of a mixture of pesticides and an increase in activity was reported. These findings further demonstrate the importance of combining bioanalytical tools to analytical chemistry in the evaluation of wastewater quality.
WE090 Fate of perfluorooalkyl substances within a small stream food web affected by sewage effluent
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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 sites. Concentration 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 accumulation of TiO2 in males than females in first months of exposure. Acknowledgements: 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) and “CENAKVA II” (No. LO1205 under the NPU I program) and by the Ministry of Agriculture of the Czech Republic (NAZV “KUS” No. QI1530120).

WE091 Patterns of natural and human-made interacting processes on source, transport and fate of trace metals in the Adriatic Sea basin
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The Adriatic Sea has been under intensive influences of human activities, which are pressuring the marine ecosystems as a whole. The morphology of this land-locked marginal sea and the intensity of human pressure on its coastline influence enhances trace metal concentrations on sediments giving rise to pollution effects especially in the northern Adriatic Sea. This work was developed under the PERSEUS EU Project (Policy-oriented marine Environmental research in the Southern European Seas), guided by the Marine Strategy Framework Directive (MSFD), which aims to achieve or maintain good environmental status until 2020 in European water bodies. Spatial and historical trends of sedimentary trace metals (Zn, Pb, Cu, Cr and Ni) and their characteristics (e.g., grain size and organic carbon) were assessed in recent layers and dated cores from western Adriatic Sea to reconstruct their sources, transport and accumulation. Our findings suggest that the Po River prodelta acts both as a bypassing and accumulation zone and exports ~30% of trace metals associated with fine particles southward, being mainly accumulated in the coastal mud wedge of the Central Adriatic. Based on the outcomes of this study, the area in the Po River vicinity could be considered an area of concern especially related to Zn and Pb accumulation. According to the requirements of the Marine Strategy Framework Directive (MSFD), we proposed a long-term monitoring plan, with a pluriannual temporal frequency (e.g., 5 years), suitable to point out possible changes in metal accumulation in the western Adriatic Sea. The anthropogenic signal of Pb and Zn can be recognized in sediment cores from the northern down to the Gargano Promontory, ~500 km away from the metal sources, with a delay of ~10 years. In line with many systems around the world, we observed a recent decrease in trace metal excess and concentration in the sediment cores from the Adige prodelta down to the Gargano, which has been mainly related to the environmental regulations enforced by governments. Finally, the main transfer process of trace metals from coastal waters to the open sea is attributed to the cascading of the North Adriatic Dense Water (NADW) 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 repository for contaminants within the Adriatic Sea.

WE092 Photocatalysis as a potential pre-treatment process to reduce organic pesticide entries
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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 can further be exposed to (un)intentional toxicity after being ingested by fish. This product 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 removal of organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland
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Bioelectrochemical systems are alternative options for energy generation through the Trinational Upper Rhine Area, a region where vine growing is one major form of agriculture. To evaluate product dependent efficiencies of TiO2 based photocatalysis, treated and untreated PPPs were analyzed for remaining PPP 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 activity, effluent treatments were analyzed for remaining PPPs by liquid chromatography. Acute toxicity tests were conducted. In detail, Daphnia magna was exposed for 48 h to (un-)treated PPPs according to the OECD guideline 202. Gained immobility data was statistically analyzed to detect significant differences among photocatalytic treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO2 to reduce PPP concentrations and associated toxicity in water when being irradiated by UV light. This product 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.

Acknowledgements: 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) and "CENAKVA II" (No. LO1205 under the NPU I program) and by the Ministry of Agriculture of the Czech Republic (NAZV “KUS” No. QI1530120).
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/m² 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 generation of energy from domestic waste for 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

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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 mixture. The removal of crystal violet from aqueous solution by sulphuric acid activated sawdust was examined. The effects of contact time and temperature (40 °C) on the adsorption of 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 removal of C. violaceum was analyzed using the ANOVA statistical analysis 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 obtained 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 (R² > 0.95). All the eight adsorbate systems investigated were endothermic (?H positive; 35.30 to 43.60 KJmol⁻¹), thermodynamically feasible (G° 2.30 to -6.13 KJmol⁻¹⁰) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment

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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, which utilises both inorganic and organic flocculants, and HØRA, which utilises a flocculant. This was also reflected in Fe and S concentrations in treated sludge. However, in LARA, concentrations of Fe, Ni and S were significantly higher in the lowe

WE096 Rapid detection of E. coli in wastewater effluent and impact of effluent discharge on riparian invertebrate diversity

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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 Phuthaditjhaba’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 effect of this pathogen into the environment, a full-scale ozonation is implemented into 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

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Microplquants (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 discharge of MPs into the environment, a full-scale ozonation 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 Wurm and at 4 sampling sites in the receiving streams and may cause various effects on the aqua...
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 Noordzeijlvest has started a pilot for reusing sewage overflow dredgings as new construction material 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 which makes the process cost-effective. All work in this pilot was done between June 2017 and June 2018. It is a long-term goal to treat the sewage overflow sediment in this way as well, expanding the pilot to 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 structured in order to prevent contamination with antibiotics. As biofilifiers, 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
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Production animal farms are proposed to act as reservoirs where genetic material from cattle are transferred to human. After fertilization, the manure-associated ARGs and MGEs were present in soil, hence a consequence of fertilization. However, the abundance and number of these ARGs and MGEs cleared decreased from fertilized soil between the 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 samples before fertilization. Likewise, ARGs abundant in unfertilized soil or in ditch water were not abundant or even detected in manure after fertilization. Therefore, the manure-associated ARGs and MGEs were present in soil, hence a consequence of fertilization. However, the abundance and number of these ARGs and MGEs cleared decreased from fertilized soil to unfertilized soil samples taken 2 and 6 weeks after manure application. During manure storage the relative abundance increased more than 4-fold for 41 genes and more than 2-fold for 62 genes. The highest increase (up to 65-fold) was observed in tetracycline-resistance genes, followed by sulphonamide and aminoglycoside resistance genes with up to 45-fold and 41-fold increases.

WE102 Bioaccumulation, biochemical responses and gene expression in the marine clam Scrobicularia plana exposed to a pharmaceutical mixture at sub-lethal concentrations
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Pharmaceuticals are pollutants of potential concern in the aquatic environment where they are commonly introduced as complex mixtures as a result of incomplete waste water treatment plant removal processes and improper disposal. Despite of pharmaceuticals occurring in the aquatic environments at trace levels (ng L⁻¹ to low μg L⁻¹), they have been specifically designed to be biologically active at low concentrations in human and animal tissues. Therefore, it is reasonable to assume that aquatic wildlife may also be susceptible to their effects particularly under condition of combined and chronic exposure. Hence the need to characterize biological effects in non-target organisms exposed to sub-lethal concentrations of pharmaceutical mixtures. Buprofen (IBU) is one of the most used non-steroidal anti-inflammatory drugs: its ability to induce toxic effects (i.e. oxidative stress, neurotoxicity, endocrine disruption, immunological alterations) in aquatic organisms at environmentally relevant concentration has been widely proven. Ciprofloxacin (CIP) and fluoxetine (FL) are broad-spectrum antibiotics of the fluoroquinolones class. Fluoroquinolones toxicity was observed in rodents.
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 (10-100 μg/L each) during 21 days with the aim of studying toxicological responses along the time. Our results show that organisms along the post-exposure decontamination. 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 decontamination: 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

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In recent decades, pharmaceuticals in the environment have been concerns for environment. Especially, in the environment, 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. The residue antibiotic usage is decreased since the enforcement of these policies, the assessment for these policies in view of environmental risk has not been performed yet. In our previous work (1), an emission prediction model for calculating the predicted environmental concentrations (PECs) of the active pharmaceutical ingredients (APIs) used not only for human but for veterinary purposes was presented. For veterinary 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 26s 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, Norfloxacin, 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 emiss...sideration, the latter two effect pathways. During the feeding activity assay, G. fossarum was significantly preferred over CIP exposure treated leaves during the food choice assays. However, the fungal biomass (an important food quality parameter) was significantly reduced in the highest CIP-treatments (0.5 and 2.5 mg/L), which indicates that antibiotics might affect the quality of the food for shredders. This assumption will be supported by the results of the long term bioassay at 0.5 mg CIP/L: likely due to an alteration in fungal biomass, the shredders' leaf consumption and growth were significantly affected when subjected to the diet-related pathway. Our data indicate that indirect effects of antibiotics on shredders via the diet-related effect pathway could be more relevant than waterborne exposure. Since shredders play a key role in the leaf litter breakdown of heterotrophic stream ecosystems, diet-related effects might result in implications for the energy dynamics of these systems.

WE106

Efficacy of removal antimicrobial resistance genes during avian manure composting process.

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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 detected 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/ABI-2747.

WE107

Environmental Assessment Of Multi-Class Pharmaceutical Residues In The Tejo Estuary

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Direct and indirect effects of antibiotics in the leaf-shredding macroinvertebrate Gammarus fossarum

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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., via altered food quality or 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 waterborne and/or diet-related pathway. All species were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norfloxacin, 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 emiss...sideration, the latter two effect pathways. During the feeding activity assay, G. fossarum was rather tolerant towards waterborne antibiotic exposure with LC50 and EC50 values of 13.6 and 6.4 mg CIP/L, respectively. Furthermore, the shredder did not show statistically significant preferences for control over CIP-exposed leaves during the food choice assays. However, the fungal biomass (an important food quality parameter) was significantly reduced in the highest CIP-treatments (0.5 and 2.5 mg/L), which indicates that antibiotics might affect the quality of the food for shredders. This assumption will be supported by the results of the long term bioassay at 0.5 mg CIP/L: likely due to an alteration in fungal biomass, the shredders' leaf consumption and growth were significantly affected when subjected to the diet-related pathway. Our data indicate that indirect effects of antibiotics on shredders via the diet-related effect pathway could be more relevant than waterborne exposure. Since shredders play a key role in the leaf litter breakdown of heterotrophic stream ecosystems, diet-related effects might result in implications for the energy dynamics of these systems.
Environmental pharmaceuticals contamination is now a recognized threat in coastal and estuarine ecosystems representing unknown and potentially harmful effects to non-target organisms. It is therefore paramount to monitor their presence in the environment and to evaluate the extent of their influence. The Tejo estuary, located only 20 km from the Atlantic coast was established as a test site for the environmental occurrence of pharmaceuticals due to the proximity to very urbanized areas in the Great Lisbon Region, with sewage disposal and discharges from industries, hospitals, agricultural and fish farms in upstream areas as well as urban effluents, anticipating the presence of contaminants. A monitoring campaign was conducted during summer where water, sediment, macroalgae, invertebrates and fish were sampled for pharmaceutical determination. Thirty sampling stations were selected according to their proximity to discharge points where effluents were expected to be rich in pharmaceuticals but also including reference sites where contamination was expected to be very low. Multi-residue multi-class analytical methods developed for each matrix are being applied for the detection and quantification of 67 compounds. The compounds monitored included antiepileptic and anticonvulsant drugs, benzodiazepines, antiarrhythmics, antidepressants, antihypertensives, and angiotensin receptor blockers, b-blockers and antibiotics (42 compounds) in a total of 67 drugs. Multi-residue multi-class analytical UHPLC-ToF MS methods developed for each matrix are being applied for the detection and quantification. The knowledge gathered will then be applied to exposure assays and antibiotic resistance studies using the pharmaceuticals detected at the highest concentrations and in mixtures. The knowledge gathered will then be applied to antibiotic resistance studies using the pharmaceuticals detected at the highest concentrations.

**WE108 Environmental risk of enrofloxacin used in aviculture**

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The use of veterinary pharmaceutical residues in animal excreta supposes a health and environmental hazard associated with its agricultural reuse. Many of them have toxic potential for terrestrial and/or aquatic organisms. The environment can act as a reservoir not only for residues, but also for antimicrobial resistance genes, and may spread them into the food chain. This is a particularly serious case in the case of antibiotics that can accumulate in soil, such as fluoroquinolones, which have a high adsorption capacity for organic matter, and a long persistence. The aim of this work focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIPR), associated with its use in poultry farming in Spain according to the technical prescriptions of the authorized products. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs. In the case of the CIPR, information has been used on the metabolism and excretion of the ENR in chickens, to establish the levels of CIPR in soil and later, to assess their environmental risk. The results indicate that the estimated PCeSoil for ENR (443 µg/kg), implies risk for terrestrial organisms, specifically in plants (RQ = 1). No risk is identified for CIPR. Finally, an ENR environmental risk map has been generated in Spain. Allowing us to identify the “hot spots” where the greatest environmental management and surveillance efforts should be applied. This spatial analysis (ArcGIS 10.2) was carried out using a simple addition method (MultiCriteria Decision) and two risk factors were included: the avian density and the capacity of the soil to accumulate this antibiotic (De la Torre et al., 2012). The environmental relevance of these results is discussed and the effectiveness of the field wise disposing in battery cages is indicated to minimize the risk of these drugs. This work is funded by RTA2014-00012– C03-02 and S2013/ABI-2747.

**WE109**

Evaluating the use of veterinary antibiotics in dairy environments to inform on contamination spread and concentration patterns. R. Baena-Nogueras, The University of Nottingham / Physical Chemistry; T. Dodsworth, The University of Nottingham / Chemical and Environmental Engineering; C. Ottori, D. Barrett, The University of Nottingham; R.L. Gomes, The University of Nottingham / Faculty of Engineering

The University of Nottingham owns a high throughput dairy farm with around 2,000 milk cows, from which the pressed liquid waste ends up in a 3,000 m³ slurry tank. Contained within the slurry we can find antimicrobial foot washings, waste milk and bedding particulates (among other components). Large volumes of liquid slurry 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 inactivation of AMR within the food chain through intake by plants and migration to other sources via water run-off, possibly affecting the therapeutic efficacy or posing a risk 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 number of antibiotic active substance as a part of repeated test. As test organisms Synechococcus leopoldinis (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 exposure 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 Gammarus 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 freshwater 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 Gammarus pulex that commonly feeds on detritus such as, naturally conditioned Alnus glutinosa leaves. The study aim was to establish if the feeding rate of Gammarus pulex was altered when their food source (Alnus glutinosa) was exposed to environmentally realistic concentrations of antibiotics during the natural leaf conditioning process. An 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 Ciprofloxacin. 24 h exposures were performed using Alnus glutinosa leaf discs of 1.3 cm O and standardised Gammarus 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 µg/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 24h the Gammarus 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=0.367)
p=0.667) were not a concern in relation to feeding at environmentally realistic concentrations (scenario 1 and 3), (p=< 0.05). When exposed to a mixture of Sulfamethoxazole and Trimethoprim (scenario 2) there was an impact on the Gamma rued feeding rate (Z=13.239, p=0.004). However, further investigation would be required to investigate these drugs individually to identify if the obtained results were driven by one or the combination, and also to establish if there is a genuine environmental concern associated to this mixture or if the data is biased in some way.

WE112 Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil

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Thousands of tons of antibiotics are annually used in human and veterinary medicine worldwide. They are excreted, from the treated organism, either unaltered or as metabolites, reaching soil and water ecosystems. In particular, the use of wastewater, sewage sludge, livestock manure and digestate as agricultural amendments and fertilizers, introduce residual concentrations of antibiotics to soils. Livestock raising practice involves the use of antibiotics in feed; consequently digestate obtained by anaerobic digestion of manure may be an additional source of antibiotics and resistance genes in soil. Sulfamethoxazole (SMX) is one of the most commonly prescribed and consumed sulfonamide antibiotics, due to its ability to inhibit Gram-positive and Gram-negative bacteria it is used in veterinary practices, agriculture and livestock breeding both for treating diseases and promoting growth. However, current knowledge about its persistence and possible environmental effects is poorly understood. In the present study, we investigated the persistence and the possible effects on the soil natural microbial community of SMX in an agricultural soil amended with solid anaerobic digestate from bovine manure anaerobic fermentation. Microcosms, containing soil and digestate treated with 20 mg/Kg of SMX, were set up in the presence/absence (sterilized soil) of the natural microbial community. Moreover, non-antibiotic-treated microcosms were used as microbiological controls. At fixed times (0d, 7d, 13d, 20d, 61d), SMX residual concentrations (ASE extraction and HPLC-UV detection) and microbiological parameters (cell viability, abundance and activity) were analysed. Finally, a molecular study of antibiotic resistance genes (class 1 integrons) was investigated at the start and the end of the experiment using qPCR. Results showed that although an acute negative effect (0d) was observed on the microbial abundance and viability, the antibiotic was degraded in just a few days. Interestingly, the int I gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

WE113 Pollution in the Mooi River: Fluconazole and fluconazole resistant pathogenic yeasts species

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The presence of yeast species in water sources that are associated with faecal pollution have been demonstrated. Some of the isolated species are potentially pathogenic and could cause superficial and life-threatening infections. Fluconazole on the other hand is the most used antifungal agent in the treatment of yeast infections as well as prophylactic agent to prevent Candida and Cryptococcus infection in HIV patients. The aim of the study was to determine yeast pollution, susceptibility of these to, and the levels of, fluconazole in the Mooi River, North West (South Africa). Yeast isolates were enumerated using membrane filtration, selective media and incubation at 37°C and identified using biochemical methods (staining and 26S rRNA gene sequencing). Resistance to fluconazole was determined by disc diffusion. Environmental DNA was isolated directly from water using membrane filtration and a commercial DNA isolation kit. Yeast levels as indicated by qPCR and 26S rRNA gene levels were determined. For fluconazole, analysis of water samples were extracted using solid phase extraction. The extracts were analysed with liquid chromatography coupled to a quadruple time-of-flight mass spectrometer. The purified isolates identified included Candida albicans, C. krusei, C. tropicalis and Saccharomyces cerevisiae. The yeasts identified have been associated with polluted waters. Some isolates in the present study are pathogenic and have a direct contact with polluted water could cause infections to immune compromised people and were all resistant to fluconazole. Quantitative PCR of the 26S rRNA gene indicated that a high number of gene copies were present at all sites. Fluconazole levels ranged from

WE114 Reactivity, mobility and degradation of the antibiotic Sulfamethoxazole and its impact on the microbial communities of an agricultural soil amended with organic waste products

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The fate of Sulfamethoxazole (SMX), a sulfonamide antibiotic widely spread in natural soils and waters, was evaluated in batches and columns of a silty-loam soil under culture from Feucheraulles (INRA Versailles, France). SMX revealed to be a weak sorbent since in batches only 10% of SMX sorbed at a solid/solution ratio of 0.1. It’s sorption increased strongly with soil organic matter content (addition of manure), indicating that the essential feature of OM addition is an increase in sorption sites density at almost constant sorption strength, and confirms previous results about the strong influence of sorbed complexants such as Cu(II). The mobility of SMX evaluated in water-saturated columns showed higher mobility of SMX than expected from the sorption study. Unexpectedly, this increased mobility was observed at higher soil moisture content, suggesting the presence of a complexant that contributes to antibiotics transport in soils. Batch degradation experiments revealed that SMX removal is quite fast with half-life values ranging between 18 and 350 days in non-sterile and sterile soils. This degradation process was shown to occur principally in both the coarsest and finest soil-size fractions, while almost no biodegradation was observed in the mass-dominant silt fraction of the soil in agreement with its low microbial biomass content. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, sul1 and sul2), DGGE fingerprinting and high throughput sequencing revealed important impacts of SMX on soil microbial biodiversity and species richness and the emergence of specific taxons, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil. SMX, present in mobile DOM with enhanced mobility in presence of added OM. SMX appeared also quite readily biodegradable, especially when in contact with coarse and fine soil size fractions, where it had the strongest impact on soil bacteria. Keywords: Antibiotics, SMX, organic matter, impact, DGGE, Miseq, ARG, biodegradation

WE115 Risk assessment of antibiotic resistance and related genes in human infected environments

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The origins of antibiotic resistance in the environment is relevant to human health because of the increasing importance of zoonotic diseases as well as the need for predicting emerging resistant pathogens. Antibiotics are used in diverse settings for food production. Domestic animals are treated with antibiotics for both curing disease and promoting growth. In aquaculture, antibiotics are used to manage infectious disease. Wastewater treatment plants receive sewage from various sources, including hospitals and households which are both important sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance is complicated. It should include at least quantitative information of the gene, sequence of the gene, host cell of the gene and genes infection targeting humans and animals. Antibiotics in particular have played a decisive role due to their ability to inhibit growth or eliminate microorganisms. Unfortunately, its misuse combined with bacterial capability to acquire antibiotic resistant genes, have significantly contributed to the escalation of life-threatening
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selectivity pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spreading serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there are considerable resistance-associated fitness costs. However, intricate bacterial compensatory mechanisms, population dynamics and long-term persistence 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 should provide environmental managers with an understanding of the potential risk of antibiotic resistance spread (e.g. via runoff). Interestingly, there are cases were 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 compensatory mechanisms (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 only partially metabolized and a large amount is excreted unaltered or as active metabolites, reaching wastewater treatment plants (WWTs). Most WWTs 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 variation and environmental release. Furthermore, environmental enrichment is not readily biodegradable and resistant to hydrolysis. The high frequency of detection and relative persistence of SMX in environment cause a potential risk of antibiotic resistance spread in ecosystems. Multiple mechanisms confer sulphonamide resistance in bacteria, although data on biodegradation and spread of antibiotic resistance genes (ARGs) in natural water ecosystem are quite scarce. The aim of the present work was to investigate the SMX degradation in natural river water in presence/absence of the microbial community and to identify the occurrence of sul genes associated to the antibiotic resistance. Microcosm experiments were set up using river water treated with 500 g/L of SMX. At fixed times, water sample were collected for chemical (SMX residual concentrations) and microbial analysis. The disappearance time of 50% of the initial SMX concentration (DT50) and the effects of the antibiotics on the natural microbial community were evaluated in terms of cell vitality and abundance. Moreover, the spread of sulfonamides resistance genes was evaluated by quantifying the sul l gene. The antibiotic SMX was biodegraded with a DT50 of about 20 days. The microbial abundance not only was not affected by the antibiotic addition (t=0 days), but at the end of was significantly higher in treated microcosms than in control conditions. The abundance of sul l increased after addition of SMX, suggesting that ARG spread is a physiological adaptation of natural microbial community to its presence.

**WE118**

*The effect of antibiotics on representatives of aquatic algal and plant species*  
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The Use of artificial high selectivity pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spreading serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there are considerable resistance-associated fitness costs. However, intricate bacterial compensatory mechanisms, population dynamics and long-term persistence 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 should provide environmental managers with an understanding of the potential risk of antibiotic resistance spread (e.g. via runoff). Interestingly, there are cases were 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 compensatory mechanisms (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.

**WE119**

*The Presence of Human and Veterinary Antibiotics in Urban and Rural Streams of North Carolina*

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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 interest in antibiotic pollution contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in water 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 antimicrobial contamination by receiving and transferring ARGs. Moreover, streams ecosystems demonstrate the potential for antibiotics to be transferred from inland areas into larger water bodies. Antibiotics entering streams can arise from various sources. In urban areas, antibiotics of human and veterinary origin can enter streams due to runoff or leaching from surrounding areas, but most notably from wastewater discharges that release direct effluents into streams. In rural areas, antibiotics can enter streams from application in the maintenance of livestock, which due to runoff and leaching, can contribute to veterinary antibiotics being present in rural streams and groundwater. Work from the present study found human and veterinary antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfafluoramide, trimethoprim, danofloxacin, sulfaquinoxaline, sulfafoxazole, 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 influence the presence of antibiotics in streams in urban and rural areas.

**WE120**

*The Role of Water Quality Analysis: Understanding our process environment to inform AMR*

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The Use of artificial high selectivity pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spreading serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there are considerable resistance-associated fitness costs. However, intricate bacterial compensatory mechanisms, population dynamics and long-term persistence 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 should provide environmental managers with an understanding of the potential risk of antibiotic resistance spread (e.g. via runoff). Interestingly, there are cases were 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 compensatory mechanisms (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 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 use rates and, as a consequence, the bacterial resistance in 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 maghemite γ-Fe₂O₃) in zebrasfish (Danio rerio). Fertil fish were divided into 4 experimental groups: control; group A exposed to 4mg/L OTC (through water) for 90 days; group B exposed to 10mg/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)

WE122 Identifying and Controlling Sources of Ultra-Trace Metals in Control Blanks and Ensuring High-Quality Data for Sensitive Environmental Risk-Based Decisions

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The control of blank contamination is a necessary requirement when evaluating the qualitative and quantitative accuracy of analytical results for decision-making purposes of site delineation, toxicological evaluations, and site remediation. This control is essential to differentiate actual site concentrations from potential sources of contamination, the contamination itself, or background site metals conditions and cleanup criteria. Trace-level concentrations of total and dissolved metals were observed in several equipment rinse blank samples collected at multiple sites during the field sample collection season of 2014 through 2016. The detection of total and dissolved metals in these field quality control (QC) samples resulted in qualification of both total and dissolved sample results resulting in questions regarding the presence or absence of low-level site contamination. Although equipment rinse blank samples do not have specific contamination acceptance criteria due to the field collection process, the goal of equipment rinse blanks is to verify that contamination was not introduced during the sample collection process or by sampling equipment. The purpose of the investigation and identification was to determine potential sources of metals contamination in equipment rinse blanks that could be identified, reduced, or eliminated. Multiple avenues of potential contamination were investigated including a study of sample tubing, peristaltic pumps and in-line filters; field observation of equipment blank collection processes; initial and post water-quality monitoring; sample bottle cleanliness and storage of deionized water for use in collection and the equipment rinse blank. This presentation will provide details of the investigation process and result of implementation of several important corrective actions.

WE123 Comprehensive Analysis of Elemental Contamination in Environmental Samples Using Inductively Coupled Plasma Mass Spectrometer (ICP-MS)


The analysis of elemental contamination is a significant task for laboratories working in environmental analysis. Besides direct regulation of contaminant levels, for example in waters, also a number of other sample types must be screened, such as soils or sediments. Targeted elements comprise the "big four", arsenic, cadmium, mercury and lead, but also many other elements. Special characteristics in this area include the need to often measure large numbers of samples and potential complications caused by a variety of spectral interferences. For example, if rare earth elements are present in a given sample, they can lead to severe interferences on arsenic and selenium. To avoid false positive results, triple quadrupole ICP-MS is ideally suited for effectively removing all potential interferences. However, the inherently higher complexity of a triple quadrupole based system in comparison to traditionally applied single quadrupole systems is a barrier for most laboratories dealing with routine analysis. This presentation will highlight the use of ICP-MS, especially triple quadrupole ICP-MS, for the analysis of environmental samples. Dedicated software solutions, such as tools to simplify method development, increase productivity or tackle advanced applications, such as chromatography/mass spectrometry (LC-MS/MS) and XRF nanomaterial analysis, will be presented to show the broadness of accessible applications using modern ICP-MS instrumentation.

WE124 Analytical Method for Determination of Fullerenes (C60) Nanoparticles in Seawater Samples

J.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 either natural 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 nanomaterial fullerene (C60) in seawater samples. It will be tested two methods of extraction: (1) 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.

WE125 Screening of per- and polyfluoralkyl substances (PFASs) and total organic fluorine in wastewater effluent from Nordic countries

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The discharge of per- and polyfluoralkyl 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 ultra-performance liquid chromatography/tandem mass spectrometry (LC-ESI-MS/MS), ultra-performance convergence chromatography (UPC²) and combustion ion chromatography (CIC). The significance of the occurrence, levels and patterns of various PFASs in Nordic wastewater effluents are discussed.

WE126 Quantitative evaluation of lag effect in polar organic chemical integrative sampler (POCIS) and modified POCIS with polytetrafluoroethylen (PTFE) membranes

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Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring techniques. 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 polar organic chemical integrative sampler (POCIS), POCIS consists of Oasis HLB® soaked membrane attached to PTFE or PES (membrane) 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

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PFTFE membrane than PES membrane for all target compounds. Two types of POCIS were then deployed in a small river and the outflow of wastewater treatment plant for two weeks. Both POCISs showed similar chemical profile and 22 contaminants were detected including 6 priority substances enlisted in EU Water Framework Directive. Although PFTFE membrane showed better permeation performance than PES membrane in laboratory experiment, the lag effect was still found from the field application of POCIS-PFTFE.

**WE128 Occurrence and Ecological Risk Assessment of Several Endocrine Disrupting Chemicals in Urban River Water and Sediment of South China**

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This study mainly focused on the occurrence, distribution, and ecological risk assessment of eight selected endocrine disrupting chemicals (biphenol analogues, parabens, and triclosan) in urban river water and sediment of south China. The eight target chemicals were detected in both water and sediment samples with concentrations ranging from not detected to 65600 ng/L and from not detected to 492 ng/g dw, respectively. Among this eight chemicals, the three major chemicals were bisphenol A (BPA) (account for 35%), methyl paraben (MeP) (23%), and triclosan (TCS) (14%) in water, while BPA (43%), TCS (37%), and MeP (14%) in sediment. Significant correlations were found between most of the selected EDCs, especially MeP and TCS both in water and sediment (p < 0.01), indicating that these chemicals were in common sources and widely usage. After calculation, our overall simulation index (SRI) in sediment targets substances flowed into Liusi river annually based on the 89 primary stream. The ecological risk assessment showed that TCS was the most dangerous compound to aquatic organisms with average HQ = 1.57 (up to 11.5) in river water and average HQ = 0.74 (up to 3.36) in sediment. And the possible joint toxic effect of selected chemicals showed that aquatic organisms were severely exposed to diverse EDCs. This study suggested that compared to the main rivers, the endocrine disrupting chemicals in streams deserves more attention.

**WE129 Occurrence, distribution and fate of pharmaceuticals as chemical markers of contamination from urban sources in the vulnerable area of the Ebro Delta (Spain)**

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The Ebro Delta and the upper part of the Ebro basin have widely been exposed to contamination from both agriculture and urban sources, being wastewater treatment plant effluent discharges the dominant contamination pathway. In order to determine the distribution and impact of contamination from urban sources in the vulnerable area of the Ebro Delta, water and sediment samples were collected at different sites, covering reaches of the Ebro river located upstream and downstream WWTPs, lagoons, irrigation channels and coastal areas. Water samples were analyzed using high-performance liquid chromatography coupled to tandem mass spectrometry using a hybrid triple quadrupole–linear ion trap instrument (UPLC–QqLT-MS/MS). In order to assess seasonal variations, distribution and fate of pharmaceuticals in coastal Mediterranean systems, three sampling campaigns in 2016 were performed, covering autumn, winter and spring-summer. Fifty seven and thirty out of 81 pharmaceuticals were found in water and sediment samples, respectively. Analgesics/ant-inflammatory, lipid regulators, cholesterol lowering statin drugs and antibiotics were the most frequently detected pharmaceuticals, with the highest concentration found in river water, while the lowest concentration were found in sea water. The occurrences of pharmaceuticals detected in sediment samples showed lower frequency of detection than in water. Nevertheless, some compounds were only found in sediments, and not in water, such as the synthetic glucocorticoid (dexamethasone), the anti diabetic (glibenclamide) and the diuretic (furosemide). Salicylic acid was the most ubiquitous quantified compound in sediment samples, with a maximum concentration of 18.2 ng/g dw. These results pointed out that pharmaceuticals are widespread pollutants in coastal environments and that WWTP effluent discharges are the main source of contamination by these substances in the Ebro Delta. Results also revealed that seasonal distribution of target compounds was affected by the river flow. Thus, concentrations of selected pharmaceuticals in samples collected during dry seasons were generally higher than those detected during the wet season, due to lower dilution factors.

**WE130 Occurrence of pharmaceuticals and personal care products, and their associated environmental risks in a large shallow lake in north China**

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Eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of four non-antibiotic pharmaceuticals (N-APs), four sulfonamides (SAs), four tetracyclines (TCs), four macroldes (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 µg/kg in sediment samples. Four M-APs were prominent, with mean concentrations of 0.97–29.92 ng/g in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APs (53.26%) > M-APs (25.39%) > SAs (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APs (42.70%) > M-APs (25.34%) > TCs (14.69%) > SAs (13.90%) > QNs (3.24%) in sediment samples, and M-APs (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.

**WE131 Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan Lake region, South Korea**

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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 predominant species from the Asan lake region were perfluorooctanoic acid (PFOA) in air, perfluoropentanoic acid (PFPeA) in water, perfluorooctanesulfonic 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.

**WE132 Seasonal changes in water and sediments' microplastics in a Mexican estuary (Tecolutla).**

L. Fischer Hernandez, P. Ramirez Romo, U.A.M. Iztapalapa / Hidrobiologia

Microplastics (MP) are persistent contaminants that 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 0.45 µm Whatman #40 cellulose (Whatman #40) filter, 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 imaging software. The analysis 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 / 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 freshwater 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 antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is oxidative biocidal treatment with the 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 is explored. The representative water treatment chemicals comprised of 1H-benzotriazole (corrosion inhibitor), DBNPA (biocide), glutaraldehyde (biocide), PEG (surfactant) and HEDP (antiscalant). 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 to monitor the CW transformation processes? How do the microbial transformation products 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 Geoscience; M.E. Müller, Eberhard Karls Universität Tübingen; F. Faltermeyer, Eberhard Karls Universität Tübingen / Center of Applied Geoscience; C. Zwienen, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tübingen / Geosciences; M. Schwientek, Eberhard Karls Universität Tübingen; C. Zarlé, 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 occurring in the surroundings. Three sites were chosen, in which sediments and water samples were also performed on the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunn 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 biological 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 Schönbrunn River and adjoining compartments.

**WE135**

Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria

O.M. Queenbano, University of Leeds / Geography (Physical); P. Kay, University of Leeds / School of Geography; L. Brown, University of Leeds / School of Geography(Physical); J. Wilkinson, The University of York / Natural and Built Environment; A. Boxall, University of York / School of Geography; L. Brown, University of Leeds / School of Geography; C. 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 trimethoprim, sulfamethoxazole, cimetidine, atenolol, and paracetamol were in the order of 150 microg L⁻¹. The mean concentrations for sulfamethoxazole, trimethoprim, cimetidine, paracetamol, lidocaine, metformin, carbamazepine and atenolol were 55.90 microg L⁻¹, 38.89 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 4.231 ng L⁻¹, other than the 10 compounds that were not detected. With the published data from around the world, these values were for 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 compounds. The compounds were also detected in surface water. Pharmaceuticals are indispensable in human lives, although, their usage and discharge into the aquatic environment could lead to ecological problems and antibiotics resistance. Africa governments 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

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 120 hectares, which has lost almost 90% of its original extension, it has been declared by the European Union as a Special Protection Area for Birds and an important feeding area for ³150000 migratory birds. The Water Nexus research program aims at developing integral solutions for water scarcity in delta areas worldwide. A significant fraction of industrial freshwater 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 antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is oxidative biocidal treatment with the 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 is explored. The representative water treatment chemicals comprised of 1H-benzotriazole (corrosion inhibitor), DBNPA (biocide), glutaraldehyde (biocide), PEG (surfactant) and HEDP (antiscalant). 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 to monitor the CW transformation processes? How do the microbial transformation products show ecotoxicological effects? Does the simultaneous biodegradation of multiple water treatment chemicals result in the production of new possibly harmful crosslinked products?

**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 Florianópolis has undergone an intense urbanization process in recent decades, which has led to the degradation of the quality of life in this region. The objective of the present study was to evaluate the water quality of the Iaçorubi river in its estuarine region, in order to evaluate the anthropic 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 analyzes of sediments and water samples were also performed on extracts obtained using SPE (Strata-X/dichloromethane). The results obtained showed high concentrations of ammonia and total phosphate, besides high sulfuric coliforms. Between the analyzed sterols, 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 Iaçorubi 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. Cuñat, University of Valencia / Environmental and Food Safety Research Group, CIDE (UV, GV, CSIC); R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive

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 120 hectares, which has lost almost 90% of its original extension, it has been declared by the European Union as a Special Protection Area for Birds and an important feeding area for ³150000 migratory birds. The Water Nexus research program aims at developing integral solutions for water scarcity in delta areas worldwide. A significant fraction of industrial freshwater 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 antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is oxidative biocidal treatment with the 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 is explored. The representative water treatment chemicals comprised of 1H-benzotriazole (corrosion inhibitor), DBNPA (biocide), glutaraldehyde (biocide), PEG (surfactant) and HEDP (antiscalant). 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 to monitor the CW transformation processes? How do the microbial transformation products show ecotoxicological effects? Does the simultaneous biodegradation of multiple water treatment chemicals result in the production of new possibly harmful crosslinked products?
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 used in the agriculture sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples were collected from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 14000 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 Strata-X cartridges and analytes were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-quadrupole time-of-flight mass spectrometry (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 peptides (leucine-phenylalanine). 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 sludge and different, such as sewage sludge.

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WE139
CHLORINATED BENZENES IN FISHES FROM DONGTING LAKE
Guanyi Li, Institute of Water Resources of Hydropower Research; F. Zhang, China Institute of Water Resources and Hydropower Research; F. Fonda, University of Ljubljana / Veterinary Faculty; I. Fonda, Fonda d.o.o.; M. Gombač, University of Ljubljana / Veterinary Faculty; V. Cerkvenik Flajs, University of Ljubljana / Veterinary Faculty; D. Miškelytė, Vytautas Magnus University; N. O. Erhunmwunse, 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; A. Mahbub, University of Benin Benin City / Department of Environmental Management and Toxicology.

The increasing levels of Pharmaceutical products in surface and groundwater in third world countries is on the increase. We examined the toxicity of one phenoxyacetic acid and triclosan (TCS) mostly carried on the 56-day juvenile life stage of Africa Cat fish Clarias gariepinus using OECD 210 guideline. A 96hrs acute toxicity test protocol for African catfish was established and adopted using a static renewal assay. Fish were exposed for 96 hours assay to varying concentrations of 50, 100, 300, 500, 700 and 800mg/L. Mortality and behavioural changes were used as endpoint for acute test. Behavioural changes were characterized by restlessness, loss of body balance, jumping, rapid and up and down movements. Estimated LC50 value was 358.80mg/L and the derived safe concentration value was 35.80mg/L. With survival from the range Finding Test, NOEC was 100mg/L and LOEC was 150mg/L. No acute toxicity effects were observed for concentrations below < 100mg/L. The 24, 48, 72 and 96hr median lethal concentration LC50 values of Aetocinamphen was 800, 700, 594.5 and 358.80mg/L respectively.

WE142
Reproductive and maternal effects of Tamiflu metabolites in medaka (Oryzias latipes)
Jinhua Deng, Zhejiang University School of Biomedicine and Environmental Biology, Kaohsiung Medical University, Kaohsiung City, Taiwan.

Tamiflu (TCS) is a broad-spectrum 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 E. fetida earthworms to chronic triclosan exposure. Earthworms E. fetida were exposed to 10-750mg kg⁻¹ of triclosan in soil for 56 days. The impact on survival, growth, 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. González García, C. Fernández-López, UCAM; F. Polesel, Technical University of Valencia / Veterinary Faculty.
University of Denmark (DTU) / DTU Environment; S. Trapp, Technical University of Denmark DTU / DTU Environment 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 and fruits were measured. Considerable amounts of reclaimed wastewater could be consumed. 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 beet 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 ACDisLab. 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 4-5), sugar, and potassium and fruit. Calculation of 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%20ant/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 Orchard Soils and Fruits in Korea B. Park, RDA / Chemical Safety; S. Lim, National Institute of Agricultural Sciences; G. Choi, National Institute for Agricultural Science; S. Ryu, RDA, International Institute of Science, RDA 

Residual organochlorine pesticides (OCPs) are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with potential significant 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, grape, peach, apple, and pear. Recovery and limit of detection (LOD) of OCPs in orchard soils and fruits were 74.4-115.6 and 74.7-92.4%, respectively. The precision was reliable since RSD percent for LOD of OCPs in orchard soils and fruits varied between 0.08 and 0.2 ug/kg, respectively. The precision was reliable since RSD percent for OCPs in orchard soil and grape, peach, apple, and pear were not detected in all samples. These results showed that the residue in orchard soils were lower level than bioaccumulation occurring.

WE146 PhytoCOTE project: Assessment of organic and inorganic contamination in vineyard soils M. Dever, LPTC / EPOC UMR 5805; M. Devier, University of Bordeaux / EPOC / LPTC UMR 5805; L. Denais, INRA BORDEAUX; H. Budzinski, University of Bordeaux Viticulture is one of the agricultural crops that uses the most important quantities of pesticides in France, in particular fungicides. These regular inputs may lead to a long-term contamination of ecosystems and thereby affect fauna and flora. Diverse processes influence the role in plant growth. In order to improve the knowledge about the evolution in time and scale of different chemical contaminants within different soil types, a state of contamination level in soil surfaces and a characterisation of trace element availability were assessed. 53 plots with important pedological diversity were sampled over the 0-15 cm horizon. The soils were characterised (organic matter, Fe and Al oxihydroxides, CEC, granulometry, pH) and total copper, cadmium, lead, zinc and 205 organic molecules were measured. The characterisation of trace element availability was performed using passive samplers (Diffusive Gradients in Thin films). A copper contamination due to past and current uses of Bordeaux mixture (copper sulphate) has been put in evidence on the experimental site (until 197 mg/kg of dry soil). 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 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. Stat, WCA Environment Limited; I. Wilson, G. Merrington, we.

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 though 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 limitations. This case study examines the situation in Scotland. Time series sampling of OCPs in orchard soils and grape, peach, apple, and pear were not detected in all samples. These results showed that the residue in orchard soils were lower level than bioaccumulation occurring.

WE148 Microplastics in Agriculture Soil. K.B. Olesen, Aalborg University / Department of Civil Engineering; N. van Aalst, Agricultural University / Department of Civil Engineering; I. Aurell, Aalborg University / Civil Engineering Department Microplastics is an environmental pollutant of worldwide concern. However, neither microplastic concentrations nor their sources or sinks are completely known. New advanced techniques such as microplastic transform infrared (µFT-IR) spectroscopy and attenuated total reflectance (ATR) enables a reliable identification and quantification of 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 in agriculture soil have been spread over a period of 35 years. The fields have 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 very small size range of interest, two different fractionation techniques are used. For a sample of this size a custom made aerator-device was built. The same device is used for aerobic and anaerobic digestion with a 1 hour cycle for 48 hours. After 2 days the valve in the top chamber was closed and ZnCl2 was added to the dish to reduce anaerobic conditions. After 48 hours the samples were analysed using the state-of-the-art µFT-IR Imaging system (128x128 pixel, focal plane Array (FPA) microscope detector). More than 500 µm kg of soil was sieved through an 8 mm, 6 mm, 4 mm, 2 mm, 1 mm and 500 µm sieve. After the soil was dried it floated in a
Will spent mushroom substrate application affect the dissipation and plant uptake of phthalate esters?

J. Gao, Institute of Soil Science, CAS / Key Laboratory of Soil Environment and Pollution Remediation, CAS; F. Zhu, Institute of Soil Science CAS

To investigate whether spent mushroom substrate (SMS) amendment was an appropriate way to reduce di(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DnBP) contents in soil and whether SMS could reduce DnBP accumulation in bok choy, two experiments were carried out to study the influence of spent Agaricus bisporus substrate application on DnBP and DEHP dissipation in soils and plant uptake of DnBP. Variations in soil pH and enzyme activities were determined. The concentrations of phthalate esters (PAEs) in soils, bok choy and atmosphere were examined with gas chromatography or gas chromatography–mass spectrometry. In addition, the effects of plant material and non-sterilized SMS on soil pH and urease activity, and non-sterilized SMS can promote soil laccase activity. The results show that the dissipation of DEHP is accelerated after incubation with SMS for 25 d, however little effect can be found with continuing incubation due to low DEHP bioavailability. In this research, SMS amendment exhibits no effect on DnBP dissipation in soils and DnBP accumulation in bok choy. It was proposed that atmospheric deposition might not be the main source of DnBP in bok choy in the study, since equivalent amounts of DnBP were detected in the vegetables grown in soils with or without DnBP spiking. This study indicates that the application of SMS as an organic fertilizer is less likely to affect the fate of PAEs in soils, and proper strategies should be conducted to reduce PAE levels in atmosphere to control PAE contamination in vegetables.

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. Pickering, 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 suitably 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 Vigor
E. Paterson, A. Thompson, Dow Agrosciences; G. Meregalli, Dow Agrosciences Italia s.r.l. / Ecotoxicology; K. Ralston, E. Paterson, A. Thompson, Dow Agrosciences; R. Wahman, J. Grassmann, Technical University of Munich; P. Scroeder, Helmholz Zentrum Munchen / Microbe Plant Interactions; G. Meregalli, Dow Agrosciences Italia s.r.l. / Ecotoxicology; K. Ralston, E. Paterson, A. Thompson, Dow Agrosciences; R. Wahman, J. Grassmann, Technical University of Munich

Non Target Terrestrial Plant (NTTP) 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 pot; 3-5 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 study, which can reduce a study being 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. Data will be presented for key test species planted at three densities to assess the impact on the Vegetative Vigour Study endpoints (expressed as ER50 values) used in the risk assessment.

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: Case Study of Pharmaceutical Contaminants in Bok Choy (Brassica rapa cv. Pekinese) Microcosm and pot experiments were carried out to study the influence of spent Agaricus bisporus substrate application on DnBP and DEHP dissipation in soils and plant uptake of DnBP. Variations in soil pH and enzyme activities were determined. The concentrations of phthalate esters (PAEs) in soils, bok choy and atmosphere were examined with gas chromatography or gas chromatography–mass spectrometry. In addition, the effects of plant material and non-sterilized SMS on soil pH and urease activity, and non-sterilized SMS can promote soil laccase activity. The results show that the dissipation of DEHP is accelerated after incubation with SMS for 25 d, however little effect can be found with continuing incubation due to low DEHP bioavailability. In this research, SMS amendment exhibits no effect on DnBP dissipation in soils and DnBP accumulation in bok choy. It was proposed that atmospheric deposition might not be the main source of DnBP in bok choy in the study, since equivalent amounts of DnBP were detected in the vegetables grown in soils with or without DnBP spiking. This study indicates that the application of SMS as an organic fertilizer is less likely to affect the fate of PAEs in soils, and proper strategies should be conducted to reduce PAE levels in atmosphere to control PAE contamination in vegetables.

Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress (P)
WE154
Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.
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Organisms are not alone in the environment. They interact with other individuals of 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 1.75mg/L) 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 combination, 8 replicates were made, 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, metabolomic 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.

WE155
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 endpoint, 8 replicates were made, 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, metabolomic 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.

WE156
Rimsulfuron toxicity and recovery in duckweed (Lemna minor)
M. Opićcarn, 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% Hoagland 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 0.0006 mg/L were reduced 25.4% relative to the controls. Interestingly, a horometric response was observed at the 0.005 mg/L concentration. In this case, the growth rate was 16.7% 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.

WE157
Toxicokinetic/toxidynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants
S. Engel, 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 impacts of PPPs on 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 lotic ecosystems (streams) in which channelised 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 we present a TK/TD model that was parameterized to describe the effects of different sulfonyleurea herbicides. The results demonstrate that the TK/TD Lemna model with its specific parameterization is able to reliably predict effects. Using the TK/TD Lemna model allows to perform a more realistic environmental risk assessment and to link time variable-exposure to effects.

WE158
Assessing soil toxicity of methylparaben using plants and collembo
da
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 not treated. Therefore, without any further studies 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 collembo. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21 days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembo 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 collembo 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 Action Program (1485014458), and the Graduate School of Specialization for
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

Weed control for the production of chemicals (EDCs) 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 phytoestrogens. An EDC that is associated with a new toxic endpoint, 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 to plant (mung bean) using traditional endpoints 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 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 research 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
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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 amino acid synthesis in plants, glyphosate exerts toxic effects on non-target organisms, probably through other mechanisms. Its entry into waterbodies means a risk for biota, particularly for the phytoplankton microalgae community, and the results of this study can be fundamental for soil risk assessments. 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.

WE162 Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment
G. Mergealli, 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 spicatum 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 colonize. 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. spicatum, 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. spicatum. 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. spicatum in 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 control invasive species need to be developed to prevent 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. Genser, Eurofins Agrosciences Services Ecotox 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 spicatum is developed to assess the risk of substances to water plants and is 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 auxinic herbicides. The OECD 239 guideline is designed to only provide a qualitative assessment of the roots. It is recommend to include measures 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 are necessary for a comprehensive 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. Kubiriza, BASF; M. Ratte, ToxRat Solutions GmbH & Co. KG

Under EU pesticide regulation, regulatory tests are required for the aquatic macrophyte, Lemna, and two algal species for herbicides and plant growth regulators. Data requirements introduced under EU Directive 1107/2009 stipulate that further tests may be required for compounds which show selectively higher toxicity to either dicotyledonous or moncotyledonous plant species in terrestrial plant tests. In these cases, the recommended dicot and monocot species

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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 testing parameters, to determine the required test conditions, 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 imazapyr, 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 UNL; 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 faciltiy in water are easily absorbed by organisms. 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 and they play a key role in decontamination of polluted environments. Ceratophyllum demersum. Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-16 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 2 days, followed, by increasing concentrations, to period of time until maximal 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), guaiacol peroxidase (GPOX) and ascorbate peroxidase (APOX) 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 mg/L presented signs of chlorosis and disaggregated easily at the higher concentrations. Metal uptake reaches the steady-state between days 11-14 and metal faciltity in water are easily absorbed by organisms. This study aimed to gain a better understanding to the physiology of T. praecox exposed to Ni and its’ Ni tolerance limits might be relevant for the potential application of this species in phytostabilization or phytoextraction technologies at contaminated soils.

WE167 Phytoextraction of heavy metals in Cienega of Tamasopo wetland, Mexico, by Typha latifolia C. Wong, C. Carranza, Universidad Autonoma de San Luis Potosi / Laboratorio de ecotoxicología; 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 [2]. Aquatic plant species are 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 phytoextraction; 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 metal 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 excluded from entering 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 phytoextraction in situ of heavy metals by Typha latifolia to determine the concentration of these metals in the plants, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega of Tamasopo where there were concentrations of Cd, Cr and Zn; 2) washing and drying of 35 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 stove; 3) grinding and spraying of root and leaves in analytical mill (KIKKA Werke M20); 4) acid digestion with HNO3 in a plate at room temperature of 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>Cu+Cr+Pb>Cu>A >Hg>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 uulu; s. martinez, CONICET PRIET UNL; s. curieses, priet conicet uulu; W.D. Di Marzio, CONICET-PRIET / PRIET Removal of heavy metals from an 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, alloy 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 abundant biological resource that possesses an inherent capacity 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 Lemna, Sporidella, 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 removing heavy metals from an artificial wastewater in a multi-metal solution. The initial whole ecotoxicity of a multi-metal system composed by Cd, Ni and Zn was assessed by growth inhibition test with the green algae P. subcapitata, acute toxicity test with D. magna and ex vivo cytotoxicity test with E. foetida coelomocytes. An experiment was set up for 10 days, by the addition of 10 grs of fresh weight of plants from different species mentioned above, in the metals solution. Previous works have shown that metal uptake rates were faster within the first 48 hours, and decrease with time and with metal concentration solution, so, at this time and at 3 and 5 days, respectively, plants were removed and new plants were placed in the same multi-metal system. At these time intervals, samples of solution and plant were taken for metal determination. The harvested plants were dried and the acornovum and a microwave acid digestion were carried out. Metal determinations in aqueous and plants sample were made by flame atomic absorption spectrometry. There was a gradual decrease in metal contents in the artificial wastewater at time intervals. The metal removal capacity was different for each specie and for each metal. At the end of the experiment, the multi-metal system treated with aquatic plants was assessed with the same battery of tests used in the beginning. The whole ecotoxicity of the artificial wastewater decrease after treatment with aquatic plants, demonstrating an efficient decrease for metal removal and recovery.
WE169
Toxicity of the binary mixture Cd-Zn on Lemma gibba evaluated using morphological and oxidative stress enzyme endpoints
s. martinez, CONICET PRIET UNLU; 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 organisms. Plants. Metals may have multiple ecological effects, some of which are 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 Lemma 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 after the end of the assays. Number of fronds, fresh weight, fronds/colonies ratio, frond area and exes' length are 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 frond 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 was no 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 activity showed higher values, 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]). 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 concentrations for each metal. A greater concentration than single EC50 for either metal was used to ascertain if the mixture presented an additive toxicity to Lemma 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. curises, J. Alberdi, CONICET PRIET UNLU; 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 issues, as human health risks and harmful effect to living organisms occurs. 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, chemical industries and abandonment of industrial areas. To overcome this problem, 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: C. cajan and M. pruriens. The selected species differ in its morphological structure and organization level as the former has a cenobial 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 73 mg/l. These concentrations were chosen based on previous experiments through range finding tests. Sublethal solutions were renewed monthly and algal cells were subcultured in new medium. After the preadapted period, each sublethal exposed algal population from both strain and one which was never exposed to the metal, considered as the control, were centrifuged. An inoculum of well cell density was prepared with each pellet, and the algae were exposed to a wide range of Chromium concentration solutions. Samples of solution and algal cells were taken for metal determination in order to dilucidate the mechanism of resistance origin. The harvested cells were centrifuged and a microwave acid digestion were carried out. Metal determinations in sublethal solutions and in algal sample were made by flame atomic absorption spectrometry. Chromium accumulation and compartmentalization in algal cells would explained the increase resistance made by flame atomic absorption spectrometry. Chromium accumulation and carried out. Metal determinations in sublethal solutions may have multiple ecological effects, some of which are 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 Lemma 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 after the end of the assays. Number of fronds, fresh weight, fronds/colonies ratio, frond area and exes' length are 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 frond 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 was no 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 activity showed higher values, 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]). 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 concentrations for each metal. A greater concentration than single EC50 for either metal was used to ascertain if the mixture presented an additive toxicity to Lemma 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.

WE171
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 outposted the Fundão dam to ten different plant species (Avena strigosos, Pennisetum glaucum, Crotalearia juncea, Canavalia ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed the method of 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 strigosos, had EC50 and EC10 in at least one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. juncea (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. juncea and P. glaucum. The results showed that: the species tested presented different indices to soil ferocity by mining waste; the activity of metallothioneins in the plants induced cease 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
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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 (OM) in controlling the ecotoxicity of CuO-NPs through bioavailability and stabilizing agent. A high OM content is likely to increase NPs toxicity by favoring their dispersion. Based on this assumption, our goal was to assess 1) whether the plant modifies the microbial ecotoxicity of NPs because of organic matter enrichment in the rhizosphere through the root exudation and 2) whether the plant variety mitigates the ecotoxicity according to plant traits. Endpoints that relate to soil ferocity by mining waste; the activity of metallothioneins in the plants induced cease 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
Observe of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure
G. Molledo, ISPRa-Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; B. Catalano, ISPRa Institute for Environmental Protection and Research; G. Martuccio, C. Sebbio, ISPRa Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; F. Onorati, ISPRa Institute for Environmental Protection and Research; A. Cicero, ISPRa Institute for Environmental Protection and Research / National Center for Laboratory Network The marine phanerogam Posidonia oceanica, thanks to its worldwide distribution
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 subtested 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. Biological markers of oxidative stress of growth velocity, 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 micromolecule frequency were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the meristem 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 toluene vapor exposure on plant metabolic changes

W. Kim, J. Park, Kwangju Institute of Science and Technology / School of Earth Sciences and Environmental Engineering; S. Kim, Kwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

The conventional damage diagnosis 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 metabolic response patterns. 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 untargeted 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

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Rosemary (Rosmarinus officinalis L. Lamiaceae) is an aromatic shrub native from Mediterranean regions, used 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 properties. 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 their tissues according to the concentration and availability of different 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) 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 (C). Phenolic compounds such as the antioxidant capacity, the phenols content, the level of lipidic peroxidation and the micromolecule frequency were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the meristem 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.
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 main objective 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 wastewater (WWTP) influenced sites. A Chironomus riparius 28-day life cycle whole sediment bioassay was performed with survival and emergence as endpoints. Simultaneously, SPME 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. Contrarily, emergence at the WWTP sites was mainly in winter and spring, while at the urban sites it was mainly in autumn. 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. Under the sediment contamination is presently understudied. It is therefore concluded that ecotoxicological sediment quality assessment needs to be included in the EU WFD.

WE180 Quantifying the Bioavailability of HOCs associated with Suspended Sediment to Daphnia magna

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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, the research has been carried out to quantify the bioavailability 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 system. The effect of pyrene associated with different SPS compositions, including among 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 C0pyrene 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 of minerals–organic matter–pyrene is significantly related to bioavailability of SPS-associated pyrene. The results showed that the bioavailability of SPS-associated pyrene was approximately 50%–60%, 10%–29%, and 20%–30%, respectively. The bioavailable fraction of pyrene sorbed on the three components of SPS was ordered as AOC (22.4%–67.3%) > minerals (20.1%–46.0%) > BC (9.1%–16.8%). This is because the SPS composition will affect the sorption of pyrene in water as well as the desorption of pyrene from SPS in Daphnia magna. The immobilization caused by pyrene associated with different grain size SPS was ordered as 50–100 μm >50–50 μm > 100–150 μm. When pyrene C0 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 50–100 μm and 100–150 μm SPS, respectively. The protein and enzymatic activities of Daphnia magna also varied with SPS grain size. The effect of bioavailability of SPS-associated pyrene mainly was 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, we have developed a model 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

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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, the University of Lorraine / Laboratoire Interdisciplinaire des Ecosystèmes et macrofaunas 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 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 metal contamination in Lake Ohrid (Albania)

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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 oldest lake in the reverse lakes of the world, was considered as an unique 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 Cu, 137.7 mg/kg for Ni, and 872.9 mg/kg for Fe. 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

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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
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 Chelx-embedded hydrogel layer, providing a measurement of labile and weakly-bound metals. To evaluate DGT passive sampling measurements as a possible indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flushing (Benelux), to evaluate the exposure of 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. During 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 water 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.
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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 designs; (ii) assess the potential use of bioturbation in the management and natural recovery of heavily degraded sediment ecosystems. Increaced bioturbation in predominantly metal-contaminated sediments increased bivalve (Tellina deltoidalis) and amphipod (Vorticorpius 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 interaction of bioturbator, species and water. Waterway nutrient concentrations and 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
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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 sediments. 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 concentrations and response in passive sampling measurements as 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 water 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.

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA
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The identification of key toxicants in urban waterways is of crucial importance to establish relationships obtained from a field experiment will 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 (1.7-4.9) and 2.0 (1.0-3.0) mg/m³ 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 (0.4 mg/m³ DGT-labile Ni) and Site 2 (1.0 mg/m³ DGT-labile Ni) sediments, respective reproductive responses were 88% (±10) and 71% (±11) of the control. This demonstrates that amendments 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. The aim was to investigate the chemistry of sediment samples from this catchment area, which is located in 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, elutriates 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

WE190 Submarine sewage outfall adversely affects the sediment quality of Santos, Brazil estuary - An acute toxicity study A dos Santos, Faculdade de Ciências Farmacêuticas - USP / Departamento de Análises Clínicas e Toxicológicas; M. Artal, University of Sao Paulo - USP / Toxicology and Toxicology analysis; J.A. Venedemati, F.I. Vacchi, University of Campinas / LEAL Laboratory of Ecotoxicology and Environmental Biology; F. Cattaneo, R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems

Swimming in turbid water: impacts of suspended fine sediments on fish physiology
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Anthropogenic activities lead to increasing sediment deposition in many rivers worldwide which must be managed to preserve industrial activities and population safety. In this context, sediment dredging aims at removing deposits which in turn impairs freshwater biodiversity. Reported impacts on fish species vary from mortality, behavioral changes, to physiological and histological impairment depending on SSC and exposure duration. Juveniles of rainbow trout (Onchorhynchus mykiss) and roach (Rutilus rutilus) were exposed in semi-static conditions (0.40, 200 and 1000 mg/L of non-contaminated fine sediments (Sedimina) for 28 days, mimicking dredging operations in terms of duration and environmental concentrations. They were sampled weekly, and mortality, condition index and growth were assessed. Further, histological gill tissue samples were taken at the end of exposure to investigate the impact of sediment exposure on fish health. The results showed exposure to sediment slurries at 200 and 1000 mg/L led to significant decreases in condition index and growth, as well as increases in mortality. Histological analysis revealed subacute and subchronic lesions in both species, with more severe effects observed in roach. These findings highlight the importance of considering sediment exposure as a potential stressor in aquatic ecosystems, with implications for the management of sediment disposal practices.
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. Roach exposure to suspended fine sediments did not induce genotoxicity or an oxidative stress. 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
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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 (re)suspension may be present in results of field studies in physicochemical forms, some of which may be unavailable, non-toxic and therefore not-harmful to organisms so that the interplay between chemical speciation and biological effects can be very site specific and hard to predict. Total sediment concentrations are therefore often found to be poor predictors of the actual risk and a measure of bioavailability should be considered in risk assessment procedures. In this regard however, the so-called Goldilocks' sediments are biologically equivalent if the bioaccumulation in exposed organisms has been experienced to be highly disruptive, time consuming and limited in comparability as its results are strongly dependent on the analysed organisms themselves. Therefore, an increasing need for less disruptive, more reliable and standardized methods exists. Recently, passive samplers have been tested to estimate bioavailable contaminant fractions as well as the contaminant flux over sediment-water interface. Diffusive Gradient in Thin film samplers (DGTs) have been indicated to provide reliable predictions of metal bioavailability and toxic potential for single (benthic) invertebrate species under (semi-) controlled conditions. The main objective of this study is to further evaluate the use of DGT passive samplers as indicators for the bioavailability of metals (bivalent and trivalent) 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 body concentration. Preliminary Risk Assessment results 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.

WE193 Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment
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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 society. Many thousand tonnons of compounds are applied in industrial processes and consumables every year. A considerable part of it enters waterbodies from diffuse and point sources. [1] Micropolllutants originating from e.g. pharmaceuticals and personal care products may cause adverse effects on different biological and ecological levels. A major concern is the fact that these substances are not fully removed during common wastewater treatment and, therefore, end up into surface waters. To minimize the discharge of micropolllutants from wastewater treatment plants (WWTP) additional treatment steps are required. Ozonation has been shown to be an effective method with reasonable costs. Hence, ozone treatment of the entire effluent is implemented in the Aachen-Soers WWTP, Germany, within the DemoAC-project. In this context, the actual ecotoxicological state of the recipient water, the River Wurm, and the upstream tributary, the River Haarbach, was evaluated before the implementation of the facility. The River Haarbach receives effluents from the Aachen-Eilendorf WWTP. Therefore, water and sediment samples from various sites upstream and downstream the WWTPs were investigated. This study focuses on the assessment of the sediment samples of the both rivers, since they play an important role in e.g. binding and remobilisation of substances. After the extraction of the sediments via a pressurised liquid extraction, cell-based biosassays with reporter cell lines will be conducted to estimate the anti-estrogenic and oxidative stress potential. Following, both native samples and extracts will be tested in the behavioural light/dark transition test with Danio rerio. This test utilizes the fish’s phototaxis (aversion to bright areas and natural preference for the dark) to evaluate effects of neurotoxic compounds within these matrices. [1] Schwarzenbach et al. (2006). Science.

WE194 Dredging sediment quality evaluation: a comparison of an ecotoxicological classification using an weight-of-evidence approach and a “pass to fail” criteria
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Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decree 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 Enviromental risk managed by ecotoxicology, M. Broort, U. Wagenia. A battery of bioassays that considers the use of three species belonging to different trophic levels has to be applied both to solid phase and liquid phase (pare 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 then the overall level of risk. The 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 worst 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 lufenerou to aquatic arthropods in laboratory bioassays
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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 effect 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 > Hyallella azteca > Asellus aquaticus and Sialis lutaria. The Hazardous Concentration to 5% of the tested species (HCS and 95% confidence limit) derived from these 10d-LC50 values was 2.2 (1.2-5.7) µg/g organic carbon (OC). This HCS value is approximately a factor of 2 lower that the 10-LC50 estimate (4.37 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 28d-LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Caenis horaria > Ephemera danica > Hyallela azteca > Gammarus pulex > Sialis lutaria. The HCS and 95 confidence interval derived from these 28d-LC10 values was 0.13 (0.02-1.50) µg/g OC. This HCS value is approximately a factor of 3 lower that the 28d-LC10 estimate for the most sensitive standard test species Chironomus riparius (0.49 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 HCS obtained from 28-LC10 values was a factor of 6 lower than the the NOEC for the most sensitive
application of an undisturbed sampling technique for depth related analysis of nutrients in water bodies. TG 219 sediment test systems, A. Dorn, Hochschule Niederrhein / Department of Chemistry; P. Dalkmann, Bayer AG Crop Science Division; D. Faber, Bayer AG, Crop Science Division / BCS D ETEX Ecotoxicology; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; M. Iäger, Hochschule Niederrhein / Department of Chemistry Sediment toxicity testing of plant protection products (PPP) is gaining an increasing awareness within the scientific and regulatory community. Currently, PPP concentrations in sediment and pore-water of Chironomid toxicity tests acc. to OECD test guideline (TG) 218/219 are determined as mean over the entire sediment layer of the test system. Hence, a depth-related measurement would contribute to a more accurate 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 (logP<sup>ow</sup> = 1) and B (logP<sup>ow</sup> = 3) 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)

WE198 Global overview of aquaculture production with a focus on the development and current status of the activity in Portugal C.V. Rocha, MARE-FUCIL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUCIL; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University Aquaculture activity experienced true global development firstly at the beginning of the 1900’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. Production from capture fisheries has relatively stabilized for the last part of the 1900’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 (logP<sup>ow</sup> = 1) and B (logP<sup>ow</sup> = 3) 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.

WE199 Characterization of the ontogenetic variation and nutritional composition of Gilthead seabream and European seabass reared in two Portuguese estuaries C.V. Rocha, MARE-FUCIL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUCIL; C. Nunes, ICECO & QOPNA, Aveiro University; M.A. Coimbra, QOPNA, Universidade de Aveiro; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; A.M. Gonzalves, MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University The nutritional value and potential ontogenetic variations of cultured fish was assessed for the European seabass and the Gilthead seabream specimens reared in semi-intensive systems in two southern European estuarine systems, the Sado and Mondego estuaries in Portugal. Quantification of total protein, carbohydrate and fatty acid profiles were determined to assess differences between the organoleptic composition of organisms of the same species reared in four different aquacultures (two estuaries in each estuary). No significant differences were found among groups of both species regarding protein content. A significant influence of the rearing site was found for the European seabass regarding saturated (SFA), monounsaturated (MUFA) and highly unsaturated fatty acid (HFA) contents, either between estuaries and within each estuary. In the Gilthead seabream, SFA, MUFA, polyunsaturated fatty acid and HFA contents were also influenced by the rearing site. Eicosapentaenoic acid, docosahexaenoic acid, arachidonic acid and linoleic acid content in adults specimens were dependent on the fish rearing site. In general, seabass and seabream fatty acid content was higher in organisms reared in the Sado estuary, when compared to the individuals reared in the Mondego estuary. Carbohydrate analysis showed a significant influence of the rearing site on free sugars and polysaccharide content in fish of both species. Differences in fatty acids and carbohydrates content among juvenile and adult stages were found for all groups studied. The present work supported the existing evidence that semi-intensive rearing systems are subjected to the variability of extrinsic factors, namely the different anthropogenic pressures these systems are subjected to, causing fluctuations in water quality and composition, which may influence the fish performance. The objective of this study was to evaluate the potential side effects of antibiotics in aquaculture in order to improve the management of antibiotic use in aquaculture systems, as well as to improve the environmental risk assessment of the aquaculture 'Blue Revolution'. Aquaculture activity in Portugal has presented a rising trend over the years, however, extensive and semi-intensive rearing systems are poorly controlled, raising questions not only about the influence of environmental factors on production, but also on the threats that the activity may pose to the surrounding environment. Among these are, for example, the destruction of natural habitats due to facilities expansion and aquaculture effluent discharges with high nutrient input to the surrounding water bodies. Careful site selection and efficient waste management plans are imperative to minimize these potential threats of aquaculture practices. Although fish supply for human consumption from aquaculture has already surpassed that of fisheries, concerns about farmed fish quality have been raised. Fortunately, it has also resulted on the honing of aquaculture methods and practices, especially concerning the control of water quality and animal feeding, in order to achieve the highest quality product.
being this slightly higher in the oxytetacycline 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 higher arborescence up to 100 μg/L, while the highest tested concentrations contributed to a decrease of the biofilm arborescence. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistome), diatoms identification, and photosynthetic activity assessment. Regarding the G. aequicuada 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 by the relevance of each of the evaluated antibiotic exposure routes.

WE201
Shifts in the diatom assemblage structure and biological traits of marine biofilm exposed to antibiotics used in aquaculture
N. García Bueno, C. Marin, A. Marin, University of Murcia / Ecology and Hydrology; B. Gonzalez-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. Intensified aquaculture has led to mounting problems with the general diseases. 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 carried out in the laboratory. In the first experiment, field-grown marine biofilms were exposed to 1, 10, 100 and 1000 μg/L each of 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 taxon abundance of the sampled quadrats 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 Cocconetes placentula. High exposure concentrations of oxytetracycline and flumequine (100 and 1000 μg/L) changed the community structure with the general decrease of Licmophora, Hyalosynedra 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 paralysis, 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 quenching of intrinsic fluorescence or on different photopigments that enables fluorometric determinations of several parameters such as the ability of reactive oxygen species (ROS) to oxidize non-fluorescent probes to fluorescent products. In the present study, the effects of H₂O₂ on Skeletonema pseudocostatum were analysed. The method provided a rapid assessment of several endpoints in the same exposed samples. Effects on growth, photosynthetic activity and the detection of intracellular ROS production, using 3 molecular probes, were measured over 72 hours. H₂O₂DFFDA was used for determining the oxidative burst, DHK 123 for mitochondrial oxidation, and BODIPY®581/591 to determine lipid peroxidation (LPO). Exposure concentrations were selected to cover the overall concentration response curve and a short-term exposure was also made to discern initial high reactivity of H₂O₂. Chemical analyses were performed to verify the stability of the concentrations during the exposure duration. The short-term exposures demonstrated rapid high toxicity of H₂O₂ to algae, where ROS production and the response to the photopigments were the observed endpoints. Over the 72 h, the response of the algae at the different test concentration clearly differed. The accessory photopigments actively responded when the main natural pigments declined. The ROS protective system seemed to be active at medium concentrations, whereas at higher concentrations damage on membranes lipids and mitochondria possibly instigated cell failure. This high throughput approach demonstrated a great potential to study the oxidizing effects of hazardous compounds in algae. While growth inhibition allowed to discriminate the overall toxicity, the high throughput methods, using flow cytometry, helped to screen and characterize the Mode of Action of H₂O₂.

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 toxicity 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 298) 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 in jurisdictions that require a different regulatory frameworks. 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
As 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 and pesticides) will continue to be used in marine aquaculture. 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
WE208
Effects of the isoflavones, genistein and daidzein, on Acetylcholinesterase from head of Solea Senegalensis.

G. Albenzio, Universidad de Cádiz (Spain) / Toxicology Area; V. Aranda, University of Cadiz / Toxicology Area; M. Manuel, University of Cadiz / Analytical Chemistry; J. Ortiz, C. Saramur, 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 pH 7.5. For each test, 12 fish 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. 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 (PAIDI 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, CÉHTRA; P. Thomas, CÉHTRA SAS; P. Baldoni-Andrey, C. GELBER, F. Mousseau, TOTAL SA

In a 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 inhibition of luminescence on bacteria in a similar way to Microtox® but its main advantages are that it is dark, juveniles are 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 OMPA. 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. 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 (PAIDI group: RNM-345).

WE307
POTENTIAL TOXIC AND PHOTOTOXIC EFFECTS OF BENZOBICYCLON 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. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

Benzobicyclon is the active ingredient in the herbicide, BUTTE®. In 2001, various formulations using benzobicyclon 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. Benzobicyclon is a prohicide 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 hydrolyzate, 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.

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. Mwakalagala, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; C.K. Simukoko, University of Zambia; 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. Mdegeka, Sokone University of Agriculture, Mali; M. Manuel, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology

Concentration of heavy metals Cu, Pb, Fe, Zn, Cr, Cd, Ni, Al and As were analysed in the muscles and livers of farmed and wild milkfish and mullets from Tanzanian coast. Fish samples were collected from January 2016 to April 2016 and analysed for heavy metals by using Atomic Absorption Spectrophotometer while analysed for heavy metals by using Atomic Absorption Spectrophotometer. The degree of exposure to heavy metals varied and was species dependent along the coast. Different levels of exposure were noted to differ at different distances from aquaculture farms is also uncertain. We have therefore developed a set model scenarios representing different medical application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DBF 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
Phototoxic Effects of Benzobicyclon 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. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

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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. Sachkov, Tomsk Polytechnic University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryashova, 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 denoted C60, C70, C84, C60, and C70, respectively, and humic substances (HS) are used here as bioactive compounds. Fullerens are polyhydroxylated water-soluble derivatives of fullerenes, HS are products of natural transformation of organic matter in soil. Bioluminescent assays allow studying toxicity and antioxidant properties of substances. We studied the toxicity effect of organic (1,4-benzoquinone) and inorganic (K3[Fe(CN)6]) oxidizers on bioluminescent tests. We found the effective concentrations (EC50) of these oxidizers decreasing bioluminescence intensity by 50%. The EC50 values of 1,4-benzoquinone were 2.5±10 M and 10 M for bacterial and enzymatic assays, respectively, while the EC20 values of K3[Fe(CN)6] were 4±10 M and 2±10 M. Also we studied the influence of bioactive compounds on the assays. They suppressed bioluminescence of the bacterial and enzymatic systems at concentrations >10 M and >5±10 M, respectively. Dioxification coefficients can be calculated to characterize changes in toxicity under the action of bioactive compounds. The values of coefficients >1 and So, the bacteria- and enzyme-based assays showed similar peculiarities of detoxification of oxidizer solutions by bioactive compounds. Results show, that low concentrations of bioactive compounds were active. Our work demonstrates a high potential of the bioluminescent assay systems, bacterial and enzymatic, to characterize and compare antioxidant activity of physiologically active compounds.

**WE211 Effect of low-dose gamma-radiation on luminous marine bacteria Photobacterium phosphoreum**

A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agroecological Technologies; D.V. Dementyev, Institute of Biophysics SB RAS / Radiobiology Lab; N. Kudryashova, 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 detect bioluminescence changes under the biological parameter test. To investigate the sensitivity of the bacteria to the low-dose gamma-radiation exposure, the irradiation conditions were varied as follows: bioluminescence intensity was measured at 5, 10, and 20° for 175, 100, and 47 h, respectively, at different dose rates (up to 1400 mGy/h). There was no noticeable effect of gamma-radiation at 5° and 10°, 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 monotonic dose-effect dependencies. The bioluminescence inhibition efficiency was found to be related to the exposure time, while no dose rate dependence was found. The sequence analysis of 16S ribosomal RNA gene did not reveal a mutagenic effect of low-dose gamma radiation. The exposure time that caused 50% bioluminescence inhibition was suggested as a test parameter for radiotoxicity evaluation under conditions of chronic low-dose gamma irradiation[1]. The reported study was funded by Krasnoyarsk Regional Fund of Science according to the participation in the event: «28th Annual Meeting of the European Society for Environmental Toxicology and Chemistry / SETAC Europe 28th Annual Meeting, International» References: [1] Kudryashova N.S., Petrova A.S., Dementyev D.V., Bondar A.A. 2017. Exposure of luminous marine bacteria to low-dose gamma-radiation. Journal of Environmental Radioactivity 169-170:64-69.
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 needles, a decrease of dormancy depth of both species clearly correlated with air pollution level, 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
Luminescent microscopy in the bioindication of the Baikal pollution with oil products and polyaromatic hydrocarbons
M.N. Saksenov, 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 could be a luminescent microscope. It has been experimentally revealed that 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 ambient water, including methods for biotesting areas is 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, Copepada) - 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 Copepoda, 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 luminosity luminescence to the possibility (that is the formation) 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. Nemtseva, O. Chmurina, Siberian Federal University / Laboratory of Bioluminescent Biotechnologies; M. Gerasimova, Siberian Federal University / School of Engineering Physics and Radio Electronics; V. Kratavskiy, 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 the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of the soil contamination.

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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: haluxifen-methyl (Arylex™ active) C. Vaj, S. Cavanova, 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, 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, haluxifen-methyl (Arylex), for weed control in broadleaf crops during 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 haluxifen-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 (e.g. pasta, bread, wheat germ, malt), and in the environment. Results will be presented and discussed. Therefore, the properties of haluxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards. 

Trademark of Dow AgroSciences

WE220 Cradle to grave Life Cycle Assessment of Traditional and Vegetative roofs J. Koura, University of Balamand / Chemical engineering department; R. Belarbi, University of La Rochelle / Laboratory of Engineering Science for Environment LiSE, V. El Khoury, University of Balamand / Chemical engineering department; H. El Zakhem, University of Balamand / Department of Chemical Engineering; M. M. El Qattaw, University of Balamand / Chemical engineering department

The aims of this study are to (1) assess the environmental performance of an extensive green roof (EGR) mock-up installed on the rooftop of the Chemical Engineering Department at the University of Balamand, in the region of El Koura, North Lebanon (34°31'N, 35°50'E) from the raw material phase until the end-of-life phase through a Life Cycle Assessment (LCA) study; and (2) compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted roof (TGBR) mock-up. In this research, the Life Cycle Inventory was modelled using the SimaPro 8.3.0 software and the Ecoinvent database, and the IMPACT 2002+ methodology was selected as the Life Cycle Impact Assessment method. Vegetative roofs seem like a possible solution for the environmental issues in Lebanon since this small Mediterranean country lacks a clear sustainability plan as well as an infrastructure update and only 13.4% of the total surface area (10,452km²) are forested area. Vegetative roofs embellish the unused roof surface available in most urban areas, increase the roof lifetime, reduce the need for a heating/cooling system as a result the building energy consumption is decreased, etc. Vegetative roofs capture a fraction of the rainfall through their growing media and the vegetation could reduce airborne pollutants. The findings of this research seem to be very promising, the extensive green roof mock-up has the least environmental impacts for all impact categories except for the “land occupation” impact category due to the vegetation layer. Moreover, a real-time monitoring of temperature was done to assess the electricity consumption or both TGBR and EGR mock-ups within the use phase. Furthermore, the sensitivity and uncertainty analyses will be performed to check the robustness of the results.

WE221 Filling whole building life cycle assessment gaps for conceptual building design V. Haas, University of Pittsburgh; J. Chhabra, G. Warn, Pennsylvania State University; M. Bilec, University of Pittsburgh / Civil and Environmental Engineering

Resource consumption, harmful emissions, climate change, and hazard events have triggered increased interest in sustainable and resilient buildings over the past 20 years. The sustainability and resilience performance of buildings has been covered in numerous rating systems and building codes; however, these are typically prescriptive methods focused on setting minimum performance requirements rather than helping us understand and optimize buildings. Life cycle assessment (LCA) and performance-based methods (e.g., energy modeling, seismic loss assessment) can be more beneficial from this standpoint but can be complex and isolated from each other. Most building LCA studies to date have limited their scope to embodied and operational energy use, due to their overwhelming impacts in conventional buildings, while some aspects, such as repair from damages (e.g., seismic) and water use have been largely missing. This study uses LCA, energy modeling, water modeling, and seismic loss assessment simultaneously to obtain a comprehensive understanding of the costs and environmental impacts of different building design alternatives. Preliminary analysis of a hypothetical building shows that in some metrics, such as cost and eutrophication, repair and water phases, respectively, can contribute more than 10% over the lifetime of the building. One design parameter expected to influence all of the mentioned performance aspects is the building form-factor, and its effect on the results will be presented. Based on the typical approach to building LCA and the shift in the sources of impacts away from operational energy as buildings transition to net-zero energy, this study investigates the potential contribution from missing phases in building LCA. This research brings together knowledge from multiple disciplines and links them through life cycle thinking, investigating the effects of building design decisions in multiple metrics. This approach can be crucial in identifying optimal solutions early on during the conceptual building design phase.

WE222 Prospects for multidimensional assessment of sustainability in urban environments F. García-García, L. Liñó, Universidad de Santiago de Compostela / Chemical Engineering; A. Núñez, L. González Louro, FEGAMP - Santiago de Compostela; E. Andrede, Universidad de Santiago de Compostela; M. Moreira, G. Feijoó, University of Santiago de Compostela / Chemical Engineering; S. González-García, Universidad de 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 constant 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 assess 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 system; ii) the frequency of occurrence in the data sets of 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 has been done by considering unsustainable and sustainable values as reference (Philips 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. CTQ2016-75316-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 population of 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 cycles stages of raw materials, applications and final 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 benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and activities that should be included in the study of the application and performance of the systems are: Acid Change, 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 the project could contribute 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 promotes 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 few years toward the implementation of sustainable technologies 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 detailing, 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 systems and activities that should be included in either road, asphalt mixes or asphalt mixes 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 mixes. 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 mixes. 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 and comparing the differences between the LCA of asphalt mixes 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 tourism facilities: demEAUmed solution A. Claret, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Vidal, C. Hidalgo, INEGI / INEGI; A. Jimenez del Barco Carrion, The University of Nottingham

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 achieve an optimal and safe closed water cycle in Mediterranean tourism 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 touristic 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, Catalunya, 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 of technologies, as well as the environmental impacts and costs are being assessed. The results 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 and 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.

WE226 Integrating Life Cycle Assessment and Risk Assessment to support decision making in the framework of Enhanced Landfill Mining G. Sarve, KU Leuven Research & Development / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering

The eco-toxicological impacts would be assessed by integrating the environmental impacts of product systems throughout their life cycle. However, when addressing waste management strategies, and in particular landfills, this tool could lead to some limitations. Landfills are in fact highly complex systems and their impacts are affected by several site- and time-dependent parameters. When assessing the potential for enhanced landfill mining (ELFM), the relative perspective of LCA may be less obvious. In terms of risk assessment, there is still a lack of detail and specific methodologies to perform a risk analysis of enhanced landfill mining. The main aim of the project is to develop a decision support tool that will allow the development of a consistent “Do Nothing” scenario for landfills for the evaluation of the environmental potential of ELFM. This can be achieved by understanding the processes underlying the emissions of different compounds and estimating the long term emission potential of landfills. In fact, landfill leachate emissions are, on the long term, the major environmental concern and the risks to human health and the environment (HHE) are dependent on environmental and time-dependent conditions. In this context, metal speciation is considered an important aspect to include in the estimation of the emission potential, as the emissions and eco-toxicological impacts of metals depend on the variation of site-specific conditions in time. In light of these considerations, a more consistent evaluation of impacts on a global and local scale and considering a long-term perspective could be achieved by integrating LCA with risk assessment (RA), which is a more site-specific tool. In fact, the evaluation of the long-term emission potential of landfills would include the definition of a fate, transport and exposure model for leachate emissions that would then be integrated in the impact assessment stage of LCA. The eco-toxicological impacts would be assessed by integrating the variation of pollutants’ concentrations in time and under specific conditions, and by including the variation of background concentrations in the receptor. Literature studies with focus on the integration of spatial differentiation (regionalization) and time-dependency (Dynamic LCA) will be used as references for the study.

WE227 Comparative environmental sustainability analysis of waste-to-energy techniques for municipal solid waste A. Ramos, INEGI / INEGI; A. Rouboa, University of Pennsylvania / Mechanic Engineering and Applied Mechanics

Progressively advancing societies generate increasingly complex mixtures of residues which led waste thermal treatment methods to evolve greatly in the last decades [1]. Incineration is among the most waste-to-energy (WtE) techniques used for solid residues treatment [2], still gasification is gaining notoriety due to its proven benefits namely concerning efficiency indicators and environmental outputs [3, 4]. Three waste-to-energy techniques for the treatment of municipal solid wastes were evaluated through a life cycle analysis (LCA) performed and compared in order to assess their environmental impacts: incineration, regular gasification and two-stage plasma gasification. The functional unit chosen was one tonne of residues over a year. The study presented here aims at highlighting and comparing the differences between the LCA of asphalt mixes 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.
WE228
Life Cycle Assessment of Pharmaceutical Waste Disposal in the UK
S. Mohamed Yunus, University of York / Environment; A. Boxall, University of York / Environment Department; E. Igos, Luxembourg Institute of Science and Technology / Environmental Research and Innovation

Unused or expired medicines from the hospital and household waste can ultimately end up in landfills or be released to the wastewater system. Therefore, there is the potential for active pharmaceutical ingredients (APIs), from a range of medicinal products, to be present in landfill leachate and sewage effluents. Unused medicines may also be returned to the pharmacist and then be incinerated as hazardous waste. In this project, a household survey was performed to understand the typical waste generation patterns for medicines and the most disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method for household waste in the UK residents with highest estimated emission of APIs to 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 were 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 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 ILCD 1.0.8 2016 midpoint with APIL. 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.

WE230
Streamlined life cycle assessment of emerging batteries in early design phases using CCaLC tool
C. Tomasin-Montenegro, KIT, Karlsruhe Institute for Technology; M. Wei, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

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In our modern and globalized society, meeting energy needs in a sustainable way pose one the biggest challenges for the scientific, political and regulatory bodies around the world. Therefore, in the context of the United Nations Development Goals, affordable and clean energy access has been defined as a reachable goal for 2030. In addition to the social impacts associated with this action plan, both tackling climate change and defining regulatory and market frameworks are common elements to identify global solutions for a low carbon energy market. Although it is recognized that geopolitical factors will shape a tailored solution for each geographical region, the use of renewable energy sources is necessary to reach a decarbonized energy supply. In particular, considering an energy system with a share of wind and solar power, energy storage technologies are required to level fluctuating energy production and demand. However, even though when it is recognized that the energy storage technologies exhibit different maturity stages, information about their associated environmental impacts is required to evaluate the sustainability trade-offs inherent to a technology decision-making process. In order to avoid environmental burdens shifting, a life cycle perspective is proposed to develop a model for the preliminary evaluation of emerging batteries or components of these batteries using CCaLC as an assessment tool. The outcome of this work is aimed at contributing to understanding the environmental impacts associated with batteries from a life cycle perspective, while evaluating the advantages and disadvantages of using CCaLC as an assessment tool.

WE232
Development of Environment Hotspots of Analysis and the consideration of availability of eco-labeling program
Y. KURAHARA, N. Itsubo, Tokyo City University

In 2014, the UNEP/SETAC life cycle initiative published a guidebook regarding hotspots analysis which enables to extract important elements from the life cycle. They defined this method as “a methodological framework that allows for the rapid assimilation and analysis of a range of information sources, including life cycle based studies, market, and scientific research, expert opinion and stakeholder concerns. The outputs can be used to identify potential solutions and prioritize actions around the most significant economic, environmental, ethical and social sustainability impacts”. Therefore, the scope of hotspots analysis covers environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEÀ2 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.

WE223
Environmental burden reduction in the FTA framework using network analysis
S. Tokito, Kyushu University

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 FTA member countries. In addition, with the import of environmental efficiency at industry level of a specific country, it is important to corporate within well-specified industrial clusters through supply chain engagement over developing and developed countries (e.g., Kagawa et al., 2015). Moreover, with expansion of trade and the international fragmentation of productions, the promotion of free trade has been increasingly required. In this circumstance, “mega-regional” Free Trade Agreement have been considered a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burden 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 induced by the production and consumption of FTA member countries. This study used the network centralty analysis, especially, the applied structural path betweennessness (Liang et al., 2016; Hanaka et al., 2017) to EORA database (Lenzen et al., 2012, 2013) and analyzed the critical sectors for the cooperation policy in the global supply chain network. From the centrality analysis, the identified critical sectors and transmitters. In the case of TPP framework, the largest CO2 emitter are “JPN. Electricity, Gas and Water” and “CHN. Electricity, Gas and Water.” On the other hand, the largest CO2 transmitter are “RUS. Mining and Quarrying—JPN. Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “CHN—JPN” in the country level. We can see the large CO2 flows between China and Russia. 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.

WE224
Developing life cycle assessment to fight climate change
P. Goglio, Cranfield University / School of Water, Energy and Environment; A.G. Williams, N. Bahta-Ozkhan, N. Harris, Cranfield University / School of Water, Energy and Environment; P. Williamson, University of East Anglia / School of Environmental Sciences; A. Marvuglia, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation (ERIN); P. Baustert, Luxembourg Institute of Science and Technology LIST / Resource Centre for Environmental Technologies (CETRE)

Climate change targets could only be achieved with the contribution of greenhouse gases from all sectors of the economy. To achieve this, it is necessary to identify the most significant sectors and transmitters. In the context of the FTA framework, the largest CO2 emitting sectors are “Japan_Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “Japan_Electricity, Gas and Water.” The functional unit of this study was 1 tonne of CO2 from the whole of Europe. The CO2 flows from the whole of Europe are classified according to their commodity, geographical region, and transmitters. In the case of TPP framework, the largest CO2 emitting sectors are “JPN_Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “JPN_Electricity, Gas and Water.” On the other hand, the largest CO2 transmitter are “RUS. Mining and Quarrying—JPN. Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “CHN—JPN” in the country level. We can see the large CO2 flows between China and Russia. 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, IAM must be used together with the LCA methodology to cover 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 FILFULMENT-IMPORTANCE MATRIX FOR ASSESSING SOCIOECONOMIC IMPACT
I. Esper Gallart, Fundacao CTRM, Centro Tecnologico; J. Bezozza, L. Vendrell, Fundacio CTRM Centre; F. Clares, Fundacao CTRM Centro Tecnologico
More often, methodologies to assess socioeconomic impact are focused just on determining just a few indicators instead impacts, which don’t use to cover 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 socioeconomics of a new process or project. This methodology is not only based in technical performance of the studied system, but also in the holistic approach offered by the LCA, LCC and sLCA methodologies. This semi-quantitative system is based on the scores of the relationship between indicators and impacts. In this way, this methodology allows calculating in which degree the objectives have been achieved, and how the impacts and indicators affect the system. One of the main strong points is its integrated approach which allows to consider the impacts of the project during different dimensions of the project. The indicators, placed in rows, are organized in four categories: technical indicators, environmental indicators, economic indicators, and social indicators. For technical indicators, data coming from performance of the system is implemented. The indicators for the environmental category are taken from LCA studied impact categories, which are supposed to be relevant for the project. In the case of the economic category, indicators studied in the LCC study are considered. Regarding the social indicators, those listed come from sLCA study. The distribution of the columns shows two parts: the fulfillment part, and the relevance part. In the fulfillment part, three columns are deployed: Baseline status, expected results set with the goals of the new project, and current or final results. On the importance part, the added columns represent the impacts of the project, which entail technical, sustainability, economic and social insights. When the impacts are selected, its importance in reference to the studied indicators must be defined based on expert know how and opinion. This importance is set by applying a value between 0 and 3. The socio-economic scores are calculated combining the importance values with the fulfilment scores. As a case study, this methodology has been applied to LIFE RELEACH project, which is aimed at managing leachates coming from landfill by concentrating technologies. In this way, the methodology has allowed to determine which socio-economic impacts have the higher contribution.

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. Cardoso, Embrapa, Federal University of Viçosa / Laboratory for Process Engineering and Applied Chemistry, EMBRAPA; P. Marques, P. Freire, University of Coimbra / ADAF-LAETA, Mechanical Engineering; P. Melo, Federal University of Ceará; M. Figueiredo, Brazilian Agricultural Research Corporation Embrapa / Embrapa Tropical Agroindustry
Agrifood industry generates large amounts of residues with potential to be used as feedstock for bio-based products. Mango agro-industry 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 compares it with fossil-based 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.

A life cycle inventory for MK-TPS was implemented based on primary data gathered at a laboratory scale. Six environmental impact categories were assessed based on the ReCipe Life cycle impact assessment method. A sensitivity analysis to the allocation approach for the starch extraction process will be performed comparing mass allocation (56% starch, 28% phenolic compounds and 16% oil) with economic allocation (using a range of expected market prices). Impacts based on allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial biodiversity, freshwater eutrophication and marine eutrophication, comparatively to LDPE. The most important contributor to impacts is starch extraction (due to hexane and methanol), except for marine eutrophication, for which the main contributor is glyceral used to produce the thermoplastic. The paper may contribute to the eco-design of a new bio-based product using an agro-industry residue as feedstock, through a Life cycle assessment based on laboratory scale data. Future studies shall take into consideration critical aspects and improvement opportunities identified through the study on a larger scale extraction process.

Environmental monitoring of contaminants using terrestrial ecological biomonitor (P)

WE239

WE240
Semi-volatile organic contaminants (SVOCs) in pine needles from Iceland M. Moeenfar, J. A. Silva, S. Ramos, LEPAPE / University of Porto; H. Ingsaran, T. Eysteinsson, T. Jónsson, A. Sigurgeirsson, Icelandic Forest Research; N. Rotała, 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 reforestation projects are now extensively widespread. Nonetheless, the concentrations of heavy metals and nitrogen found in mosses and needle samples of the most frequently widespread species in Iceland, viz. Pinus sylvestris and Pinus mugo, were quite similar to the values found in mosses and tree needles in other countries. In this study, we used a few of these findings to propose a new methodology for the detection of heavy metals and nitrogen using mosses and pine needles as biomonitor for atmospheric deposition in Germany. Ecological Indicators 76:194-206, [12] Schröder W, Nickel S, Breyer D. (2017) Nutzung von Bioindikationsmethoden zur Bestimmung und Regionalisierung von Schadstoffeinträgen für eine Abschätzung des atmosphärischen Beitrags zu aktuellen Belastungen von Ökosystemen. 4. Zwber. & F&E UFOPLAN 3715632120, I.A. UBA, Dessau. Text: 82 S. 4 ANh. 212 S. Keywords: Bioaccumulation of atmospheric deposition, European moss survey, heavy metals, nitrogen, Acknowledgement - The authors thank the German Environment Agency for funding.
WE241
Study of global diffuse pollution levels in remote high mountain areas and their impact on the organisms from these ecosystems
K. M. Pratt, Institute of Environmental Assessment and Water Research (IDAEA-CSIC) / Environmental Chemistry; B. L. van Drooge, IDAEA-CSIC / Department of Environmental Chemistry; P. Fernández, B. Pita, J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry
Global diffuse pollution results from the emission of multiple sources and long-range transport. Effects of this background contamination have been observed in the recent past in fish from remote high mountain lakes through mRNA measurements in which showed feminization effects and oxidative stress (S. Jarque et al. 2015). Although some of these effects were related to persistent organic 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. There, they can adsorb on sediments, rocks and, depending on the physical-chemical properties of the pollutants, they may bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the present work. The six remote high mountain lakes investigated were located in the National Park of Aigüestortes i Estany de Sant Maurici (Pyrenees). They encompassed an altitudinal gradient from 1680m to 2500m asl. 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. S. Jarque et al. (2015). Background fish feminization effects in European remote sites. Sci. Rep., 5, 11292.

WE242
Spatial distribution of mercury and trace metals in epiphytic lichens in Nova Scotia, Canada
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Mercury is a persistent pollutant present in all ecosystems. The prevalence and spatial pattern of mercury will determine its movement in the atmosphere and potential to bioaccumulate and biomagnify through food webs leading to mercury contamination 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 concentration was observed among the sites, with higher THg concentrations found in the northern part of the province. A spatial analysis was used to display and model these regional trends. While broad spatial resolution was the initial focus for these collections, a few target areas (biological mercury hotspot Kejmukjuk National Park and historic gold mining areas) were also sampled in more intensively 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 biomonitor of air quality is inexpensive and effective.

WE243
Biological monitoring of environmental quality near a solid waste incinerator in central Lithuania
G. Sujetoënë, P. Smigalitis, Vytautas Magnus University
Solid waste disposal has huge environmental impacts including toxicins, leachate and greenhouse gases. Lichens (L. prunastri) and Ramalina (L.) Ach. were used for biomonitoring purposes in an area of the largest solid waste landfill in central Lithuania. Lichen transplants were exposed for 3 months. Chlorophyll content increased in both transplanted lichens with increase in distance from the landfill. Chlorophyll content in lichens was significantly lower in the nearest study site in comparison with the control. Potential values were expressed as F/P, in lillu was lower under the influence of solid waste incinerator in comparison with the reference. Higher chlorophyll degradation was characteristic to the transplanted lichens under the influence of landfill. The conductivity of leachate and content of thiobarbituric acid reactive substances (TBARS) increased in lichen material transplanted at sites facing the landfill. The results showed that biological monitoring can be useful tool for landfill quality.

WE244
Nothing it what seems: Levels of PCDD/Fs in the surroundings of a hazardous waste incinerator
M. Marques, Rovira i Virgili University / Chemical Engineering; M. Mari, University of Siena / Department of Chemistry; I. Corsi, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Fattorini, University of Siena / Department of Life Sciences; I. Corsi, University of Siena / Department of Physical, Earth and Environmental Sciences
PCDD/Fs are quite lipophilic, and thus their concentration in the lichens depends on the proximity to the plant. The incinerator of TarraONA (Spain) was selected as study site, and from the data obtained during the first 10 years of operation, a temporal trend was observed in the levels of PCDD/Fs in the vicinities of the plant. The results were based on PCDD/Fs in soils and vegetation samples collected on two campaigns, 1998, 2015, 2016 and 2018, respectively. No statistical differences were found between 1998 and 2015 campaigns. Comparing the study of 1998 (median: 0.75 pg I-TEQ/g (dw)) with these carried out in 2015 and 2016, the concentration of PCDD/Fs statistically decreased by 41 and 55%, respectively.

WE245
The use of land snail Cornu asperum as sentinel organism to monitor air pollution
L. Sturba, M. Vannuccini, G. Liberati, F. Nannoni, G. Protano, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Fattorini, University of Siena / Department of Life Sciences; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences
The use of bioterrorist organisms for monitoring air pollution allow to assess real hazardous effects of airborne contamination over a geographical and temporal scale depending on selected species and scientific approach. The present study aimed to validate the use of the land snail Cornu asperum as bioindicator of airborne pollutants effects by transplanting snails in plastic cages positioned in urban area strongly impacted by several industrial activities nearby. Ten sites were selected based on the distance and winds directions from the main industrial area in order to assess pollutant distribution in terms of bioavailability and biological responses in a relatively short period of time. After four weeks trace metals levels in soft tissues of whole organism and several biochemical responses were investigated in different sites and organs as: lysosomal membrane stability (LMS) and Micronuclei (MN) in hemocytes and antioxidant enzymes Catalase (CAT) and Glutathione-S-transferase (GST), lipid peroxidation (MDA) and total Metalllothionein proteins content (MTs) in midgut. Results obtained by generalized linear mixed models (GLMMs) revealed significant correlations among trace metals levels and biological responses investigated and with the distance from
the main industrial site. Based on such findings and previous evidences of the ability of this species to respond to vaporized metals as cadmium in laboratory controlled condition, the present study support the suitability of C. aspersum as bioindicator for heavy metals exposure in air pollution monitoring studies.

WE246 The relationship between lead exposure on dogs and their behavior around Pb mining area, Kabwe, Zambia

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Lead (Pb) toxicity on both of human and animals has been known and caused neurological symptoms and even death in the worst cases. Our previous study has revealed Pb exposure on domestic dogs around a Pb mining area, Kabwe, Zambia. There was a trend that Blood Lead Levels (BLLs) in dogs in sites near to the mining area were higher than those in sites far from the mining area. Moreover, the difference of BLLs in the same area among individuals was found. This difference may be attributed to some factors, and behavior of dogs could be one of the important factors. The present study was undertaken to determine a relationship between Pb exposure on domestic dogs and their behavior recorded using GPS machines around the mining area in Kabwe, Zambia. Blood samples of domestic dogs which were freely roaming in the area were collected twice before putting GPS and after a week. BLLs were analyzed by LeadCare II. GPS devices were set to log every 1 minute and 30 seconds and attached to dog collars. In total, 53 male and 48 female domestic dogs were sampled. The overall mean of BLLs before and after a week were 24.2 μg/dL and 24.8 μg/dL, respectively. There was no significant difference between BLLs before and after a week. GPS log data was averagely collected for 4.4 days and the means of distances of dog movements per day was 17.6 km. There was no significant relationship between distances of dog movements per day and the gap of BLLs in dogs between before and after a week. The distance between the mining area and dogs’ home was significantly negatively correlated with BLLs (p < 0.05). The previous study revealed the concentrations of Pb in soils were negatively correlated with distance from the mine. These trends suggest that the distance from the mine is a key factor of Pb exposure on dogs. In the present study, there was a significantly negative correlation between BLLs and the distance from the mining area. In contrast to our hypothesis, there was no significant relationship between BLLs in dogs and their behavior. It suggested that mature dogs in the study area could be highly exposed to Pb regardless their behavior. An additional study focusing on the behavior of young dogs which are more vulnerable to Pb could get a different result of the relationship with their Pb exposure.

WE247 Monitoring and impact assessment of terrestrial ecosystem using Eisenia fetida affected by chemical incidents

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Many chemicals can be accidently spilled in the environment and it is important to know their presumable toxicities on the living organisms to determine risk assessments. There are no information on the terrestrial organisms of six chemicals possibly spilled into the environment, containing sulfuric acid, methanol, methylthylketone, nitric acid, formic acid, and toluene. In this study, we conducted acute toxicities of these chemicals on Eisenia fetida in an artificial soil according to the OECD guideline 207. We used E. fetida adults grown in our laboratory for 10 generations in soil consisting of pig manure composts fortified with steamed sweet potatoes at 25°C. The earthworms used in this study were sexually developed with an average body weight of 100 to 200 mg. The artificial soils were composed of industrial sand (70%, 50 to 100 micron particle), kaolin (20%, pH 4.5 to 7.0), and peat (10%). After mixing the components, pH was set in a range of 6.0 to 6.5. At least five diluted serial solutions were used to determine LC50 values, whereas pure aceton was used in the control group. LC50 values of sulfuric acid, methanol, methylthylketone, nitric acid, formic acid, and toluene were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 μg/g soil, respectively. These results are very different from the acute toxicities using filter papers, which toluene exhibited 26-fold lower acute toxicity than sulfuric acid, the strongest toxic compound among the tested chemicals. Using the filter papers, methanol and methylthylketone did not possess a negative effects on the earthworm. With these results, earthworms may act differently to the chemical incidents in relation to their residential condition when they expose to the chemicals.

WE248 Biochemical and behavioural responses in two endogeic earthworm species exposed to parathion

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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. Here two endogeic and abundant species in the agricultural systems (Achroa 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 [ChE] activities) were measured after 7 days of pesticide exposure. Our results clearly showed species-specific differences in response to pesticide and behavioral indications of A. caliginosa the most sensitive species to this pesticide under the exposure conditions of our study. Although ChE 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 ChE activity of both species had the OP sensitivity. However, an in vitro inhibition trial with ethyl parathion 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.

WE249 Cr transport in sweet peppers plants cultivated with vermicomposted tannery wastes

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Untreated waste water and solid waste generated by the tanning 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, mainly caused 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 pepper plants cultivated with vermicompost to determine if this is a bioremediation strategy and the leaf Cr transport from the vermicomposts and its possible transportation through the plant, the content of Cr (III) and Cr (VI) were evaluated in all the binary soil-plant: soil (at begging and post-harvest), roots, stalk, leaves, and mature fruits. 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 accumulation showed a high percentage of Cr transported to the leaves. 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

WE250 Insecticide resistance in the natural enemy F. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide.

A. Le Noyeun, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unité PSH, Equipe Ecologie de la Production Intégrée, Site Agroparc; Y. Capowiez, INRA Avignon; M. Rault, UAPV/IMBE / IMBE UAPV UMR 7263, Pôle Agrossences Apple orchards are highly treated crops, in which organophosphorus (OP), neonicotinoid and synthetic pyrethroid compounds 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 this group of insecticides on the 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 (CtEs) were studied, by measuring their activities on earwig 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 the residual, and earwigs sampled from contaminated areas. 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 CtEs. Moreover, we observed that basiac-activities of CtEs and GST of unexposed individuals are higher in conventional orchards compared to IPM and organic ones. All these observations support the hypothesis of a molecular target modification in AChE conducing to a decrease of affinity with the insecticide, and highlight the role of CtEs 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 isotope 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 and δ15N values, indicating a C3-plant-based food source. In contrast, the butterfly, moth, and litchi stinkbug all represent a C4-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 δ13C from larvae to adults. Principal component analysis (PCA) was conducted using the fraction composition of HOPs were performed to evaluate the species-specific bioaccumulation. Different species of insects exhibited different contaminant patterns, which could be attributed to their habitats and feeding strategies. For example PBDEs were predominant in the dragonfly collected from the pond, which has been seriously contaminated by electronic waste; however, DDTs significantly contributed to the total HOPs in the butterfly and moth, and in the litchi stinkbug, and their host plants also have a high DDTs concentration. In addition, it is a common multi-linear correlations between In adult/larva and log Kow of the compound was observed for the four taxonomic insects. The ratio of larva to adult decreased with increasing values of log Kow (log Kow < 6-5), then increased (6 < log Kow < 8) and decreased again (log Kow > 8). The results of this study demonstrated that a common mechanism is responsible for the fate of HOPs during metamorphosis in those insects.

WE252
Glyphosate: toxic or not toxic, this is the question

M. Verderramo, R. Scuderi, University Federico II / Department of Biology Insect pest problems are a major biotic and abiotic threat for agricultural systems (GBH), 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 an irritant” and by the EFSA as “no carcinogenic to humans”, converging evidence 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 Glyph-treated males also displays the biosynthetic alterations typical of an estrogenic contamination: hepatocyes, in fact, contain transcripts for both vitellogenin and estrogen receptors. At reproductive level, male gonad is affected by the treatment. Spermagogenesis is slightly slower, at low dose of Glyph scattered spermatocytes II fuse into spermatoid-like shape arrangement, at high dose the amount of rosettes increases. Some spermatids are damaged, 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 Glyph exposure, no matter the dose. Our results suggest that Glyph 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 human populations.

WE253
Concentration of perfluoroalkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs

C. Mazzon, S. Lai, Università degli Studi di Milano; M. Mazzoni, University of Insubria; C. Mazzon, University of Insubria; D. Trevisani, University of Milano; E. Andreoli, University of Milan; N. Saino, University of Milano; M. Parron, University of Milan / Department of Environmental Science and Policy; S. Valsecchi, Water Research Institute; G. Carina, University of Milano; M. Mazzoni, University of Insubria; D. Trevisani, University of Insubria; R. Scuderi, University of Federico II / Department of Biology 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, University of São Paulo USP; T. H. Trevizani, Universidade de Sao Paulo / Instituto Oceanográfico; M. Petti, University of São Paulo USP; R. C. Figueira, University of São 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 yolk in oogenesis 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, hepatopancreases and gills) of G. cruentata and compare populations from contaminated and noncontaminated areas. Samples were collected in two mangrove areas in São Paulo State, Brazil. The contamination levels of each area were determined 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 > hepatopancreases > 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 were 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 chinensis)  
X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem; L. Wang, 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 polychlorified biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenyltrichloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the watersnake embryos is gaining increasing research interest. DDTs are still found in the fish and snail. Few studies are focus on viviparous species, but ovoviviparous species have not yet been studied. It is known that watersnake (Enhydris chinensis) 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 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 DBDPE, showed ratios of EMR, and EMER lower than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. A multi-linear relationship exists between EMER and log KMow of the chemicals for the watersnake. For compounds with high hydrophobicity (log KMow > 8), a negative relationship between EMER and log KMow is observed (p < 0.05). For compounds with log KMow < 8, the values of EMR and EMER were smaller than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. The deposition of contaminants in watersnake eggs are obviously different with other species in previous study, which implied potentially high inter-species differences in the maternal transfer mechanism.

**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-EMI-MS  
F. Neugebauer, Eurofins GfA Lab Service GmbH / R&D; A. Dreyer, Eurofins GfA GmbH; N. Lohmann, Eurofins 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 suspensions) and as particular matter as representatives 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, PBB, HBBz, DPE, PBDE, HBBz, DTB, BTBPE, DEC, Dec602, Dec603, Dec604, DMPA, ClO11-antiDP, Cl11-antiDP, syn-anti DP, anti-anti DP, DBDPE). 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. Pajula, 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 dealing with the quantitative and qualitative 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 reducing 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 or the production service. The footprints are assessed by using 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 rising 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 properly 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 a life cycle upstream process chain. The processes from $2364/year to $1857/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases are in China, where the manufacturing processes take place. The rest of Asia, Australia, 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 processes. We compared the results in comparison to the downstream life cycle impacts. This implies that despite the apparent advantages of ‘clean’ renewable electricity production at the deployment location, the majority of ecosystem service damages might be relocated to other parts of the world.

**WE259**

Recent advances in natural capital accounting  

At the recent World Forum on Natural Capital (27-28 November 2017) a wide range of corporations, stakeholders, academics and policy makers 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 natural capital?” (Cohen 2014) highlight the 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-equipped for seeing the dependencies between ‘capital’ as most cost-benefit analyses used in everyday decisions assume that natural capital can be easily substituted by mankind capital, when in fact it cannot; and (iii) we lack appropriate political and economic institutions to manage natural capital effectively. Two opportunities emerge
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 local 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 nature’s 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 quantitative. One of the strongest themes was that we all need to improve our story telling across multiple disciplines and institutions.

**WE260 A Life Cycle Costing and Analysis of a Hybrid-Electric Engine**

G. Bailey, KU Leuven / Material Sciences; W. Dewulf, KU Leuven; K. Van Acker, KU Leuven / Materials Engineering

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 sustainability of the HEV 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. Reference: G. Bailey, M. Mancheri, N. Van Acker, 2017. Sustainability of Permanent Rare Earth Magnet Motors in (HEV Industry. Journal of Sustainable Metallurgy, 3, 611-626. nBIELLO, D. 2016. Electric Cars Are Not Necessarily Clean. Scientific American. Scientific American, a division of Nature America, Inc.,nHICKMAN, L. 2012. Are electric cars bad for the environment. The Guardian. nPUBLISHERS, I. 2008. Hybrid Electric Vehicles Not As Green As They Are Painted (The Content Online). Inderscience Publishers/nAvailable: www.scieducally.com/releases/2008/02/08/02/079433/4.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**

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Dietary patterns have a significant impact on greenhouse gases (GHGs), and diet of an average Spanish. Future requirements and policy recommendations

**WE262 Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars**

P. Girard, P.C. Brambilla, RSE Spa / SFE

The scope of this study is to compare the externalities of electric, gasoline and diesel motorisations of an average passenger car (aW 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 year of the foreseen rate and the per capita GDP of considered countries. Moreover, the damage factor of PM 2.5 have been divided in three differents damage factors taking into account the different population density of urban, suburban and rural areas. These external costs evaluations shows the Electric Golf performs better in terms of external costs, mainly thanks to the minor costs due to Climate Change. As regard regional externalities, the external costs due to emissions in Italy make the electric vehicle even more competitive than considering the overall regional externalities.

**WE263 Life Cycle Costing: methodological description and implementation**

B. De Caevel, J. Dulbecco, RDC Environment; A. Ciroth, GreenDelta; T. Huppertz, I. Descos, RDC Environment; J. Garcia, SCORE LCA

The complexity of production processes and products combined with an increasing interest in sustainability has created the need to monitor and analyze not only the production phase, but also all upstream and downstream costs. 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, maintenance 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 environmental impacts. The LCC method has been widely used by researchers 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 understanding 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 and examples. 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 coupling of LCC and LCA coupled with LCA.

**WE264 Pizza: it is dangerously delicious!**

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The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributed 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...
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 demonstrates 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 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 framework that most precise FU is to measure protein sources based on 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

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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 humans or animal and it is crucial to them through food or feed intake. AA are also used as supplements in animal feed, providing the possibility to increase protein content of feed. Protein production has a major impact on the environment: it is responsible of ~14.5% of all human caused greenhouse gas emissions but also requires large amount of land and water due to the high quantity of crops required for feeding animal. Consequently, comparing protein sources using Life cycle assessment (LCA) is important for decision-making. However, choosing the functional unit (FU) is often a critical issue for food systems. The quantity of food (i.e. 1 kg) is the most used FU currently. Nevertheless, this FU does not represent the function of food that is to provide protein. A more precise FU is to compare protein sources based on their protein content (i.e. 1 kg protein). To have a more holistic approach, nutritional and qualitative aspects should also be included in the FU. Actually, most plant protein sources do not bring all EAA required. In this study, the Protein Quality Index (PQI) developed by Sonesson (Sonesson et al., 2016) was applied as a FU. It takes into account aspects such as EAA digestibility, AA requirements but also food habits. In our study, PQI was conducted on several protein sources coming from conventional (pork, chicken meat, salmon and tofu) and non-conventional sources (insects and algae). The role of the AA supplementation in animal feed was also investigated. On the one side, the analysis has shown that non-conventional protein sources perform better in all environmental categories, independently of the choice of the functional unit. Tofu performs better than animal protein but the difference between animal and vegetable based proteins becomes much lower when a more elaborated FU is used. On the other side, the supplementation in AA allows a reduction of the environmental impact of chicken and pork. Using the PQI as a FU, the impact of chicken and pork with AA supplementation is even lower than the one of tofu in some categories. Using the PQI as a FU is a step toward a more holistic assessment. A next step might be to include other nutrients such as iron and vitamins in the FU.

**WE266**
The ISO/DIS 14008 standard: Monetary valuation of environmental impacts and related environmental aspects - Principles, requirements and guidelines - and their implementation

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**Key words:** monetary valuation, framework, standard, ISO 14008 The use of monetised environmental impacts and associated aspects 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 ususally necessary to monetize those impacts and 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. To achieve this purpose, standardised and transparent documentation of the methods used to derive monetary values is essential. The multiplicity of monetary values, methods to determine monetary values, and ethical perspectives on money, requires careful consideration and prudent communication. ISO/DIS 14008 provides a framework that includes principles, requirements and guidance for monetary valuation of environmental impacts and related environmental aspects. Many methodological requirements or 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 take into account 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 material flows as a resource and a barrier as a possible option. In SSL, framework and building blocks of the framework are defined, an overview 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. Aptiz, 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 they value and what values they wish to sustain. In selecting indicators to represent stakeholder values, the challenge is to build a conceptual framework with modules based on lessons learned from earlier cases.
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 considered. Threshold criteria ensures that stakeholders 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, groundwaters and soils (P)

WE269 Effects of long-term exposure to increased salinity in the amphibian skin bacterium Erwina toletana
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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; 18 g/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 PEG-based molecular method (BOX-PCR). Results of growth showed that long-term exposure to NaCl slightly increased the tolerance of E. toletana to this salt, EtC50 for growth were: 22.5 g/L (8.64-36.4) for Et-LB; 30.3 g/L (23.2-37.4) for Et-NaCl, and 26.1 g/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
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Salinity is considered one of the main 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 sites, 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 flowing from areas with intertidal agriculture. This water led to an increase of flooding periods, a decrease of soil moisture and the macroinvertebrate community from the low salinity site

WE271 Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?
B.J. Jefford, 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 this 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 microbes) 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 (Ca2+, Mg2+, Na+, K+, HCO3−, SO2−3, Cl−), or increases in the Ca2+ and Mg2+ 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. Water hardness is a naturally occurring water quality parameter, 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 collected for the review process included available scientific literature, but the current literature often did not meet the criteria for 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 exemplary 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, phosphorous and microplutonants) 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 taxon recovery by restoring the salt gradient increasing fresh water input.

WE274
Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity
P. Srihumsuk, 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 identified as new sources of salinity and potential toxicity to the environment, particularly in regard to the implementation of structures properly arranged to slow down the freshwater dispersion and to favour reed 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 on the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.
major inorganic ions (Na⁺, Ca²⁺, Mg²⁺, K⁺, SO₄²⁻, Cl⁻), pH and electric conductivity (ECₑ), 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 crusting problems, as well as, potential yield reductions in the most significant crops of the Alqueva perimeter. Higher ion concentrations related with the major water salinity with the selected water points of the atmosphere evaporative demand. Sodium hazard assessment showed slight to moderate risk of reduced infiltration rates, a result that should be taken into account when surface or sprinkler irrigation systems are used. Furthermore, relative yield reductions may be mainly found in horticultural crops, classified as moderately sensitive to sensitive in the salt tolerance scale.

Systems ecotoxicology: application of OMICS data across multiple levels of biological organization in research and risk assessment (AP)

WE279 Investigating wildlife diets using high-tech DNA sequencing
J. Ludwigs, Rifcon GmbH; I. Katzschner, RifCON GmbH Goldbeckstr Hirschberg Germany; G. Weymann, ADAMA; A. Winkler, J. Kaliñowski, Center for Biotechnology (CeBiTec) Universität Bielefeld

In wildlife risk assessments according to EFSAs (2009), the ingested diet is one of the core factors to define exposure, using default diet compositions in the first tier risk assessment. The speculated PD factor (composition and portion of diet) is one of the standard refinement parameters which intend to add realism to higher tier risk assessments. Publicly 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 are based on known food habits, study for their inclusion in test toxicity tests. 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, (i.e. dicotyledons plants or monocotyledons 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. Martínez-Guitarte, UNED / Fisica Matematica y de Fluidos Molecular endpoints are increasingly under investigation for their inclusion in test toxicity 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 is divided into several regions (e.g., head, thorax, abdomen). 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, (i.e. dicotyledons plants or monocotyledons 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.

WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis
J. Semmoun, Ghent University (UGent) / Animal Sciences and Aquatic Ecology; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecol; R. Jansen, 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 period of twenty-five years and is likely to rise 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-seqencing 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 transcriptomic 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 baseline 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 Vinne 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 levels, and (ii) between the different stress treatments. 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, CEFBA / Functional Ecology Laboratory; 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, Association of Retired Environmental Scientists ARES / Department of Ecological Sciences; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria
Folsomia candida is a widespread arthropod that occurs in soils throughout the world and has been used as a standard test organism in past decades for estimating the effects of pesticides and environmental pollutants on non-target soil arthropods. This species is among the most sensitive representatives of its taxon, being selected as a genomically model organism for soil toxicology studies. Although laboratory
experiments with a transcritomics approach are essential to unravel modes of action of chemical compounds, higher-tier studies (e.g., field studies) are crucial as a validation criterion in environmental risk assessment trials, while their ecological relevance is increased when complemented by pertinent information at lower-tier studies (molecular level). Therefore, the main goal of the present study was to validate the mode of action of a commercial fungicide formulation in *F. candida* under a more realistic field exposure scenario, by targeting specific molecular biomarkers retrieved from a previous laboratory and rodent organism’s pool of data and survival and reproduction effects in *F. candida* exposed to a commercial formulation of the fungicide chlorothalonil (40% Bravo®500) in a natural agricultural Soil under laboratory conditions, organisms were now exposed under field conditions for 4 days to the same concentration as for laboratory exposure (causing a 75% reproduction on reproduction) and the Predicted Environmental Concentration (5 mg a.i/kg). Invertebrates were previously cultured in laboratory and simultaneously 12 replicate soil cores per treatment (including control) were collected from the field and defaunated. The cores were placed back in the field and 220 organisms (10-12 days old) were added per replicate core. Field contamination was made by spraying after a 3 hours accretion period to the field by the organisms. RNA was extracted from each pool of organisms using the TRIZOL® methodology. According to previous laboratory “omics” results with the same study design, a set of specific genes were selected for a targeted gene expression analysis by qRT-PCR, corresponding to key genes of affected biological pathways including glutathione metabolism, oxidation-reduction, body morphogenesis and reproduction. This work contributes with a set of molecular biomarkers which can be used to develop a more effective set of tools to assess the early effects of such fungicide formulations in a real scenario of soil contamination.

**WE284**

Proteome response of *Chironomus riparius* under exposure to the neurotoxic insecticides Spinosad and Indoxacarb

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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 can 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, spinosad 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 unexposed organisms. As expected, the pesticides exposure triggered different responses at the proteome level. Changes caused by spinosad were more noticeable than for indoxacarb exposure. Our results revealed a general decrease in the expression of globin proteins with the increase of spinosad concentration. Additionally, for spinosad, a significant decrease in the expression of an actin and a cuticle protein were also observed. Moreover, correlations between proteomics data and induced alterations in both biochemical and morphological parameters on both spinosad and indoxacarb treatments were found. 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. *Chironomus riparius*, a model organism in aquatic toxicology, is also presented as a promising model organism for environmental proteomics.

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**WE286**

Assessing *Cu* impacts on freshwater diatoms: biochemical and metabolomic responses of *Tabellaria flocculosa* (Roth) Kützing

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Metals are a recognised threat to aquatic organisms but the impact of metals such as copper (Cu) on benthic freshwater diatoms is poorly understood, even if diatoms are commonly used as water quality indicators. Our study aimed to elucidate the cellular responses of diatoms to Cu toxicity. The freshwater diatom *Tabellaria flocculosa* (TFL), isolated from a Cu contaminated stream, was exposed to 0.3, 6 and 10 µg Cu/L, and the tolerance level and the cellular targets were studied using biochemical, physiological and metabolomic approaches. Cu was already toxic to *T. flocculosa* at concentrations common in environments which are usually not 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 influenced by a higher production (ETS activity, use of sugars and 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 hydroxyamine and unsaturated FA and the increase of saturated FA, 2-palmitoylgllycerol, glycine and dihydroxy 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.

**WE287**

Non-targeted approach to identify metabolic perturbations in gilt-head bream liver and brain exposed to benzenophene-3

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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 specific molecular effects on both liver and brain exposure, 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 -80°C 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 MZmine 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, some metabolites were significantly altered in liver and brain exposed to BP-3. Metabolites driving group separation were further investigated using the Kyoto Encyclopedia for Genes and Genomes (KEGG) in order to determine affected pathways. Overall, these data demonstrate the potential of metabolomics in the study of the full complexity of biological responses to contaminants. Keywords: Benzenophene-3, gilt-head bream, non-target metabolomics Acknowledgements: This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56268-C3-1-R. H. Ziarrusta is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

**WE288**

EFFLUENTS 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. Oprea, Universidade Federal de Santa Catarina / Biochemistry Department; R. 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 paper industry, in comparison with that of the offspring of embryos from respective 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 h 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
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 profile 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 Centre EPFL; D.R. Caputo, 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 age agents are increasing in aquatic environments globally, commonly requiring sustained research effort. In this study, a suite of biomarkers was used to evaluate the effects of sewage effluent exposure on the amphipod Gammarus fossarum. After validation in further studies, the biomarkers will be used to assess the effects of sewage effluent on other aquatic organisms.

**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 Biosciences; 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 organise 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 accurately determining 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 in response to toxic insults, using a multi-omics approach.

**WE291 Elucidating interactive toxic effects of copper and lead on marine mussels: molecular to physiological consequences**

C. Crowther, V. Sharma, Plymouth University; A. Turner, Plymouth University / Food Safety; A.N. Jha, Plymouth University / Biological Sciences

It is increasingly recognised that anthropogenic contaminants are not isolated in their threats to the aquatic environment. Recently there has been a shift towards measuring the effects of exposure to low-concentrations chemical mixtures under chronic conditions to predict outcomes on the ecosystem. Adopting an integrated approach the aim of this study was to assess the interactive effects of copper (Cu) and lead (Pb) either alone or as a mixture at various levels of biological organisation, ranging from molecular to individual levels. The combination of proteomics, molecular and physiological measures with bioinformatics adopted in this study will allow a model of mixture exposures to be created which can be translated to early warning indicators within the marine environment.

**WE292 The Identification of Toxicological Markers in Adverse Outcome Pathway Discovery in Chlamydomonas reinhardtii**

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Current regulatory toxicity testing methods have become unsuitable for the thorough assessment of chemicals for commercial use, as lack of insight into toxicological mechanisms prevents accurate predictive risk assessment. Adverse outcome pathway (AOP) approaches offer a framework for collating 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 literature 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 thiorodoxin 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. Together, these results revealed how the marker of oxidative stress 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 synergistic 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)

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Poly cyclic aromatic hydrocarbons (PAHs) are a class of ubiquitously distributed environmental pollutants that mainly originate from petrogenic and pyrogenic sources such as combustion of fossil fuels and other organic material. Various PAHs, including benzo[a]pyrene (BaP), have been demonstrated to cause a wide range of effects in exposed wildlife, including alterations of immune responses, impaired development and reproduction, as well as mutagenesis and carcinogenesis. Most studies to date, however, have used comparatively high exposure concentrations, dietary routes of exposure or intraperinentional injection to administer BaP, and knowledge of low-dose effects at concentrations around water solubility (approx. 4 µg/L) is generally limited. This route of exposure, however, must be considered highly relevant in light of the distribution of PAHs even into remote aquatic systems. To bridge this knowledge gap, early-life stages of the fathead minnow (Pimephales promelas) will be exposed to waterborne BaP as a model compound to characterize toxicity pathways that drive the sensitivity of early-life-stage fish to PAHs. Molecular responses at the whole transcriptome, proteome and metabolome level will be investigated at the swim-up stage, and quantitatively correlated with effects on apical (growth, survival, development), histopathological, and biochemical endpoints 28 dp post-hatch. The data generated within this experiment will help to better understand the relevance of aqueous exposure to BaP specifically, and PAHs in general, and provide important insights into the relevance of molecular responses in early-life stages as early-warning biomarkers for apical outcomes in juvenile and/or adult fish. This study is part of the EcoToxChip project (@ecotoxchip).

WE294
SETAC OMICS Interest Group

B. Campos, Unilever R&D / Environmental Chemistry

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (P)

WE296
Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications

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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 in response to environmental stimuli. The best studied epigenetic mechanisms are methylation forms on cytosines in a CpG context and post-translational 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. The acquired histone PTM code give insight on how these modifications regulate gene expression and crosstalk with each other and with DNA methylation. Chromatin immunoprecipitation (ChIP) is the standard assay of choice for analyzing the genomic localization of histone modifications. Exposure to the well-known epigenetic modulator, the DNA methylation inhibiting agent 5-Aza cytidine, resulted in a global reduction of DNA methylation in Daphnia magna (one gene, H3K4me3 remains unchanged on the investigated loci). The unchanged response in ChIP was contradictory to significant gene expression responses and to what was expected of this epigenetic modulator. The present study therefore demonstrates differentiated response of LC-MS/MS, ChIP-PCR and gene expression to 5-Aza cytidine exposure when characterizing epigenetic stress response in D. magna. Acknowledgements: funding from the Norwegian Research Council (NRC) project 223268 (CERAD).

WE297
Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution

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MicroRNAs (miRNAs) are a class of small non-coding RNA. These 20-24 nucleotides-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 and pesticides. 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 serve to identify native 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)

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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 present in the F2 generation, but not the F3 generation. Our data supports the hypothesis that exposure to low levels of copper during early life has the potential to reduce the susceptibility of a vertebrate model across generations. We hypothesise that the multigenerational tolerant phenotype observed was caused by parental effects serving to alter developmental endpoints and hence general copper tissue burden in F0 adults, resulting in secondary exposure of F1 embryos and their germ cells which gave rise to the F2 generation.

Emergence and multidimensional interactions of engineered nanoparticles in toxicity (P)

WE299
Do global warming increase bioaccumulation of copper nanoparticle in

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SETAC Europe 28th Annual Meeting Abstract Book
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 is known about the effects of warming whether increase the bioaccumulation of carbon based nanoparticles in freshwater fish. The purpose of this study was to assess whether warming synergistically increase the bioaccumulation of copper nanoparticles in tilapia (Oreochromis niloticus). Tilapia were randomly exposed 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 pattern of the particle on muscle. 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

D. Kühnel, University of Siena / Department of Physical, Earth and Environmental Sciences; A. Ale, Inali-Conicet; C. Jimena, Instituto Nacional de Linnmologia (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 manufactured nanomaterials (C-MNM) 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, bioconcentration, 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-chemical mixture exposure with uptake and toxicity is rather diverse. Based on the observations made, 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 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 (7) 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 of chemical mixture combinations. The resulting nomenclature is consistent and detailed enough to describe accurately the observed mixture effects. The tiered approach results in a consistent terminology which unambiguously describes 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. 05X0131.

**WE301**

Investigating the Trojan horse effect of nanoparticles on an aquatic community - An outdoor mesocosm study

T. Strauss, Research Institute gaiac; gaiac - Research Institute for Ecosystem Analysis and Assessment; S. Claasen, Research Institute gaiac; T. Knautz, M. Hammers-Wirtz, Research Institute gaiac; gaiac - Research Institute for Ecosystem Analysis and Assessment

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, potential toxicity etc. In this study we explored the food web dynamics using the model organism zebrafish and the bioaccumulation of 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 the 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 on single species as well as on community level endpoints like diversity were evaluated. The taxonomic group of interest was cladocertan zooplankton (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

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The use of silver nanoparticles 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 as the Mytilus galloprovincialis in terms of biological responses and Ag accumulation. Animals were in vitro 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 micronuclei frequency (MN) were measured in mussel’s hemocytes. Catalase (CAT) and glutathione-s-transferase (GST) activities were measured in digestive gland as well as the content of malondialdehyde (MDA) 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 mussel’s 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 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

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The gold nanoparticles are widely used in medical therapy and cosmetics. In order to provide a comprehensive understanding of the potential biological effects of gold nanoparticles, a review of 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 nanorods (Au-NR, 45nm) in the feeding rate, growth and enzymatic activity of tadpoles of the amphibian species Xenopus laevis. A short term experiment under environmental term exposure scenarios. The observed toxicity of NanArge underlines the need to further test commercial formulations of nanotechnology-based consumer products instead of bare nanoparticles in order to properly assess any risk associated to their use and release into aquatic environment and in non-target aquatic species.

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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 involving anaerobic metabolism. Furthermore, an enhanced reactive oxygen species (ROS) may have led to the inactivation of catalase and the induction of Ca2+, related with the mechanisms of cell apopitosis. Thus, the induction of GST at the two highest Au-NP concentrations, suggest that the cells are inactivating the Au-NP by its 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 and compriose their fitness. Further, 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 biocide triclocarban and weathered multiwalled carbon nanotubes (wMWCNT) in freshwater algae: chronic effects & bioaccumulation

L. Poliowski, 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) is a novel environmental challenge. However, due to the low water solubility of MWCNT, their release into aquatic systems will be limited. Nevertheless, 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 undergoes 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 sorption properties to other contaminants like triclocarban (TCC). This study aimed to assess the ecotoxicological consequences related to the mixture effects of triclocarban (C16H8Cl3NO5S) and low wMWCNT amounts. Comparative assessment of the interactive effects of Carbon (C) and Low wMWCNT amounts. Comparative assessment of the interactive effects of Carbon (C) and Low wMWCNT amounts.

**WE305** Comparative assessment of the interactive effects of Carbon-based nanoparticles and Benzo[a]pyrene on zebrafish embryos

C. DellaTorre, University of Milano / Biosciences; A. Ghilardi, S. Magni, University of Milano; N. Santo, University of Milano / Biosciences; D. Maggioni, University of Milano; C. Landi, University of Siena; M. Parolini, University of Milan / Department of Environmental Science and Policy; L. Madaschi, University of Siena; C. Simaccini, University of Milano / Biosciences; L. Bini, University of Siena; L. De Giacomo, University of Milan; A. Binelli, University of Milano / 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) on zebrafish embryos. For this aim 500 μg/mL CNPW and 500 μg/mL C60 were added to the zebrafish embryos. Both CNMs were purposely selected as they have different biological properties: CNPW are considered as an environmental contaminant and C60 is a drug used in cancer therapy. The effective sorption of the hydrocarbon on CNPW was quantified. A thorough evaluation of chemical-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 toxic 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 responses were induced by the CNMs and the compounds were not just additive but induced a specific interaction.

**WE306** IN VITRO TOXICITY OF MODEL ZnO NANOPARTICLES ON HEMOCYTES OF MUSSEL Mytilus galloprovincialis

I. Politowski, University of Patras / Department of Environmental and Natural resources Management; N. Anastassi-Papathanasi, University of Patras / Department of Biology; E. Mouzourakis, Y. Georgiou, University of Ioanna / Department of Physics; S. Dailianis, University of Patras / Department of Biology; Y. Deligiannakis, University of Ioanna / 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, hemocyte concentrations, suggest that the cells are inactivating the Au-NP by its 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 and compriose their fitness. Further, 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.

**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 / UTCOX; K. Schirmer, Eawag / Environmental Toxicology; A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environment of Aquatic Systems

The use of omics is rapidly increasing in the field of nano-ecotoxicology; 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 treatment and untreated samples (qFDR).

**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.J. Janer, Leitat Technological Center

The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is widely used in a variety of new cutting-edge applications.
In this study, the effect of the mixture on intracellular calcium release will be investigated applying the following methods: 1) The molecular mechanism of nTiO2 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 or nTiO2 are channel blockers, the expression of gon-2 will be increased in the absence of Cd and nTiO2. However, if Cd or nTiO2 are channel blockers, the expression of gon-2 will be increased in the presence of Cd and nTiO2.

2) The mode of action of nTiO2-Cd-agglomerates is still not identified. They could interact if Cd is bound to nTiO2, or if Cd and nTiO2 are in close proximity. The impact of nTiO2-Cd-agglomerates will be examined using calcium as a potential competitive ligand. 3) The photocatalytic activity of nTiO2 could damage cell membranes under SSR and Cd could enter the cell. Measurements of membrane integrity with propidiumiodide and hexokinase will be tested. First results will be presented.  

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cetyltrimethylammonium bromide (CTAB) was quantified by exposing both algae to the concentration of CTAB present in the highest tested concentration of Au nanoparticles (R. subcapitata) corresponding to 0.257 μM of CTAB. Chlorarella vulgaris exhibited a higher tolerance to Au-NR than R. subcapitata: EC50/72h for F0 was 79 μg/L and 39 μg/L, respectively. For C. vulgaris, a gradual increase of its tolerance to Au-NR was observed over generations; after being exposed for four generations to this chemical, many effects on growth rate were nanoparticle species compared to CTAB was not changed. The results obtained in the present work reveal that standard traditional assays with short-term exposure may over- or underestimate the real risk posed by Au-NR to freshwater microalgae. Therefore, it is suggested that long-term exposures should be included in the ecological risk assessment.

**WE313**

Effects of climate change combined with copper nanoparticle on early development of Japanese medaka (Oryzias latipes)

I. Meng Ian, Y. Zhang, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung

Nowadays, global warming and acidic acidification were occurred by rising carbon dioxide (CO2). The project have been continuously emit copper nanoparticle into ocean and river. They probably induced harmful biological effect on organisms. However, the combined effects of three environmental stressors on aquatic species have not been well studied. The purpose of this study is to assess the effects of aquatic acidification and warming combined with copper nanoparticle on survival and hatchability of early development of Japanese medaka (Oryzias latipes). Fish were exposed to 25°C/6.5 to 25°C/7.5 and without copper nanoparticle under 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) 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 for 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 proving increasingly important interactions with the immune system. The PANDORA project (Probing safety of nanoobjects, and predictive markers of risk vs. safety, with a collaborative cross-species comparison) seeks 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 acidic acidification. 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. Ogungbenuli, M. Yallop, 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 technology in the last decade have 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 impacts 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 interaction of the exposure medium. In this research, the combined toxicity of heavy metals (Cu and Zn) and their metal-oxide nanoparticles will be evaluated in a benthic estuarine microalgae - Cylindrotheca closterium. We hypothesize that the aggregates formed by the metal-oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction to the benthic system. In this study, the impacts of Cu and Zn NPs on the growth and development of C. closterium in the presence of different concentrations of Cu and Zn NPs will be investigated.

**WE317**

Comparative toxicity of silver nanocolloids and titanium dioxide nanoparticles using medaka

Y. Kato, Toyo University / Faculty of Life Science; T. Ariyoshi, C. Katakawa, S. Kashiwada, Toyo University / Graduate School of Life Sciences

Silver nanoparticles and titanium dioxide nanoparticles are representative nanomaterials and are used in multiple products that impact 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, Φ0 40 nm) using medaka model. SNCS have hemolytic (at 0.5 μg/mL of SNCS) and larvae (at 5 μgL of SNCS) toxicities including lethality, inhibition of embryo development, suppression of 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 infective bacterial disease (Edwardsiella tarda). In SNCS exposure, we reported that silver chloro-complexes, which were made of dissociated silver ion from SNCS, should be essential toxicants of SNCS exposure. On the other hand, titanium dioxide nanoparticles (TiO2-NP, Φ90 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 muscul. We have assumed that ion dissociation will be a key to understand nano-toxicity depended on materials. \( \text{TiO}_2\)-NP which does not dissociate ions, was employed as a reference to ion dissociation NP (i.e. SNCs). In exposure of \( \text{TiO}_2\)-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 \( \text{TiO}_2\)-NP regarding general toxicity, oxidative stress, cytotoxicity (apoptosis and necrosis), immuno-toxicity, and tolerance to antibiotic bacterial disease. Through this study, we will figure out that dissociated ions should be toxic essential of nanomaterials, and not always nano-sized 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. Zaleska-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 physical and chemical 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 so-called indirect 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 single 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-Al2O3). Light microscope, DAPI 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 \( \text{Al}_2\text{O}_3\) macro form. The nanocompound caused changes in the genetic material of bacteria \( \text{A. hydrophila} \). Determination of the sensitivity of obtained particles and bacterial strains 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-\( \text{Al}_2\text{O}_3\), 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-\( \text{Al}_2\text{O}_3\) 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. V. Simms, G. P. Cobb, Baylor University / Department of Environmental Science

Copper oxide nanoparticles (nCuO) and arsenic (As) phytotoxicity to rice plants (\( \text{Oryza sativa} \)) was evaluated in a factorial study using (0, 1, 10, 50, 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. Toxiciants 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 planting, continued through germination, and to seed production. Thus, our study is the first to examine the influence of nCuO in combination with As throughout 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 (NRP). The interaction of the two toxiciants was also significant 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

J. Marabell, Universitat de Alcal\'a; K. Boltes, University of Alcal\'a / Chemical Engineering; P. Leti\'on, Universitat de Alcal\'a

Behavior of cerium oxide nanoparticles in presence of pharmaceuticals. In exposure of \( \text{CeO}_2\)-NPs on three aquatic specimens- algae \( \text{Nannochloris capricornum} \), bacteria \( \text{Vibrio fischeri} \), and activated sludge, by detecting concentration-dependent effects 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/L. The particle size and the \( \zeta \)-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 \( \text{CeO}_2\) 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 \( \text{Vibrio fischeri} \). Exposure produced significant oxidative stress in bacteria forming activated sludge, with lower damage to enzymatic activity. The presence of pharmaceutical compounds did not produce significant changes on nanoparticle behavior for activated sludge. Results indicated that algae was more strongly affected than the marine bacteria and activated sludge, respectively. These can be attributed to the culture media and organisms structural characteristics, respectively. [1] Neale PA, Jamting AK, O'Malley E, Herrmann J, Escher BI. 2015. Behaviour of titanium dioxide and zinc oxide nanoparticles in the presence of wastewater-derived organic matter and implications for algal toxicity. Environmental Science & Technology: 49, 9, 5391-5400. [2] Salerni-Demessie E, Changseok H, Amy Z, Bill H, Heidi G. 2016. Interaction of engineered nanomaterials with hydrophobic organic pollutants. Nanotechnology 27:284003. Acknowledgement - The research was funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMTFAVARES.
malate dehydrogenase and α Mannosidase, respectively. A high-purity vacuum (99.5%) and cytosol (86.7%) fractions of the cells of *Nitellosis obtusa* were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytoplasm and vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytosol. The data on Cu accumulation dynamics within the compartments after cell exposure to rCaO 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 hemmexis in vitro?**

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In the aquatic environment, complex mixtures of pollutants are usually found. Polymeric aromatic hydrocarbons (PAHs) are priority 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" carriers' role of graphene nanoplatelets (GPNPs). The aim of this work was funded by the EU HI2020 (GRACE project) and Spanish MINECO (project NACE, CTM2016-8130-R), Basque Government (consolidated research group IT810130), and University of the Basque Country (UFI 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**

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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 morphological pathways in response to exposure to silver (AgNPs) and titanium dioxide (TiO2) nanoparticles (NPs). Pathways and/or of changes observed; (3) if the ageing of particles make them more or less toxic; (4) if long-term 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 expression compared to control populations, supporting that AgNP and TiO2 have toxicological impacts from chronic exposure irrespective of particle aging. TEM observations of subsequent 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. Basirico, 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 in order to investigate the influence of dissolved oxygen and 3° temperature of the overlying water column, and the percent sediment moisture 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 of 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. The current research suggests that sediment organic matter and environmental parameters 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; I. 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-derived 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 regresional design to evaluate how an acute desiccation event shapes the response of a complex microbial community (i.e. a river biolim) 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, denitritification and methaneanogenesis. 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
reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism powers biochemical 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 fluoxetine 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 disproportionally 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 climate models forecast an increase in these two human induced stressors. Yet, in spite of 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 fluoxetine, a human medicine commonly found in freshwater systems, causes greater lifetime fitness costs when associated with increased variability in temperature. Although fitness effects were significant when comparing control temperature (17 °C) and 21 °C, no significant effect was observed when comparing control temperature (17 °C) and 21 °C in the presence of fluoxetine (17 °C; 21 °C F). Fluoxetine concentration (final concentration: 0.5 mM) was kept the same for both control and temperature treatments, when each stress act on alone. Further 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
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Several studies already described the impacts caused by metals in estuarine species, often linked to multiple human induced stressors. Our results indicated that organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress acts 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)
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Reduced energy use was observed for the same period at 17 °C in the absence or presence of Hg (21 °C: 21 °C Hg) or kept for the same period at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg), and biomarkers related to mussels’ metabolic and oxidative stress was evaluated as well as Hg biocommentation. Our findings revealed that independently on the temperature regime, organisms previously exposed to Hg followed by a 28 days period in the absence of Hg were able to significantly decrease their metal concentration. Furthermore, energy-related and oxidative stress markers in mussels exposed for 28 days in the absence of Hg demonstrated no differences between mussels exposed to warming conditions (21 °C) and control temperature (17 °C), with a tendency to reach control values (observed in mussels exposed the entire experiment to 17 °C in the absence of Hg).

WE330
Transgenerational effects of pesticide on vector mosquito Culex pipiens under global warming
T. Tran, L. Janssens, KULeuven; 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 bifactorial transgenerational experiment. Parental exposure to warming, 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 divison 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 synergetic 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. Petersen, CASB, Department of Biology; J. Titelman, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; K. Borga, 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 Tintinnopsis brevispinata. The aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent development. 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
same mode of action may be applied to describe the short term effects of complex (CA) model for the prediction of the toxic effect of mixtures of chemicals with the experiment was performed using lenthic mesocosms in Central Spain under clothianidin) on freshwater macroinvertebrate and zooplankton communities. The potential to non-Neonicotinoids are a group of insecticides that are used worldwide in agriculture A. Rico communities under Mediterranean conditions WE333 information for understanding soil ecosystem functioning and recovering. related with the activity of b, CF =42%, P =39%, S= 31%, P+MS =21%, AF =8%, DP+MS =7%. Total and hi bags decomposition showed two different tendencies: DP+MS, P+MS and S had a the most toxic fraction, were largely higher in S (e.g. Pb≈4600; Zn≈210000). Tea the capacity (CEC), an indicator of the buffer capacity SETAC Europe 28th Annual Meeting Abstract Book...
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, physicochemical properties like pesticide structure, solubility, adsorption, and degradability seem to be crucial for the interaction with nTiO₂, NOM, and UV-A, 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. Tagliapietra, 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 into the skin by swimmers and swimmers, 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 mimic commercial available sunscreen formulations. Two Symbiodinium phylotypes, 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 nanomaterials showed 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 against photolytic degradation, 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 algae growth over the decreasing and direct released of the water, posing 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 aquatic 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, an important water source for 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 to determine the selected 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 done among sites. Positive correlations were found between metal concentrations in 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 bioacumulation of earth metals (e.g. Al, Fe, Mn, Ti). This 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.)
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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 round 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 biodynamics a 3-4 years old genetically modified morphs of bush snails Bradybaena fruticum (Mull.) were used collected from Moscow city (Kartmazovo, Kuz’minki,Ismalovsk Park) with respectively different HR of the mollusk biotopes. Cardiac activity registration in selected groups of mollusks was performed in Sevastopol Bays using salinity change test. Possible links between chemical pollution by dioxin (in terrestrial snails) and heavy metals contents in mollusk’s tissues (in marine mussels) and peculiarities of HR recovery after thermal or salinity loads were discussed.

WE339 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
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 concentration 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. In the 48 hour half maximal concentration (EC50) and median effective time (ET50) values were tested with ciliate 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°C 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 temperature value of 16°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°C 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.

WE340 Pattern oriented food web modelling of metal mesocosm datasets
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The risk assessment of metals has a long history and over time a large collection of
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 mesocosms are much more complex and difficult to interpret. A study has been set up to investigate whether food web modelling can 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. With this approach, multiple combinations of 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 Ruditapes philippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Biomonitoring and Prevention of Impacts; V. Bernareggi, A. Toccafondi, C. Vighi, ISPRA Institute for Environmental Protection and Research; F. Cacciatore, F. Martella, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; C. Alonso, P. Garcia, A. Castaño, IIT Hyderabad / Civil Engineering; C. Dassuncao, Harvard University

Many marine ecosytems are being affected by climate driven changes in freshwater discharge, circulation, productivity and seawater temperature. Large ocean predators such as tuna are particularly vulnerable to these changes because of their high mobility and large geographic range. Overall, the effects of climate change on marine ecosystems are expected to be more widespread and severe than those on freshwater ecosystems. However, the magnitude of changes in marine ecosystems expected from decadal oscillations in seawater temperature in the North Atlantic. We compare the magnitude of these changes to those occurring in the Pacific Ocean and discuss how climate related variability is likely to affect exposures of humans and wildlife to toxic pollutants. Our results suggest changes in tissue burdens driven by oscillations in seawater temperature are similar in magnitude to those that have been achieved by reductions in emissions in the North Atlantic.

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; A. Qureshi, IIT Hyderabad / Civil Engineering; C. Dassuncao, Harvard University

E. coli is recognized nowadays. Mangroves are one of the most threatened tropical ecosystems as their loss due to industrialization, coastal protection, and agricultural and urban development is accelerating. The declining health of mangroves is likely to affect species that rely on them for food, breeding, and shelter. It is important to assess the effects of climate change on mangrove ecosystems in order to better understand their vulnerability and potential resilience.


Combination of chemical pollution and water scarcity are one of the most important threats to aquatic ecosystems in (semi)arid regions of the world. The low dilution potential of chemicals (urban, industrial and agricultural) discharged in aquatic ecosystems under water scarcity conditions could lead to devastating toxic effects. Moreover, a large proportion of aquatic bodies in these areas are characterized by high hydrological variability in a temporal scale. In this sense, communities naturally adapted to this condition are expected to respond differently to the chemical stress than those adapted to more constant water flows. The aim of this study was to evaluate the combined effects of multiple stressors on aquatic ecosystems in scenarios that are characteristic of (semi)arid regions. In particular, this study focused on identifying the main stress factors that are influencing aquatic communities in the semi-arid region of Madrid (central Spain). Sixteen sites were selected in the watershed of the Tagus River (Madrid, Spain) and sampled in three different seasons (spring, summer and fall). Hydrological and physico-chemical parameters of aquatic ecosystems were monitored, together with concentrations of metals and organic contaminants (pharmaceuticals, home care products, pesticides). With respect to organic contaminants, the results from a screening analysis revealed the presence, at detectable levels, of 100 compounds in water samples. A group of 42 contaminants were selected for quantification due to their known potential to aquatic organisms and frequent detection. Complex mixtures of pharmaceuticals, as well as highly toxic pesticides were identified. Through a multivariate analysis including pollution data, flow variability and related physico-chemical parameters, the main stressors and possible differences at
a temporal and spatial scale were evaluated at a taxonomic and at a biological trait level. Significant responses to multiple stressors from some invertebrate taxa and functional traits (feeding habits, reproduction and respiration) were determined. Based on these results, suggestions for a biological vulnerability multivariate index, which considers more site-specific conditions, will be presented.

**WE345 Long-term effects on transplanted caged-freshwater bivalves Diplodon chilenis to the assessment of water quality in a Patagonian river**

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**FCEN-UBA; S.E. Sabatini, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Biochemistry.**

The influence of extreme 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 *Hordheum vulgare* under well-watered and water deficit conditions in Close-top chambers under closed 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 biomass 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 antioxidant enzymes. Full recovery of physiological processes and ward in conditioned were brought (5% v.v.) under well 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 *Hordheum vulgare* plants suffered markedly stronger physiological and oxidative stress caused by combined treatments as compared to the water deficit treatment and revealed an importance of soil water availability even during the short-term heat wave period. **Keywords:** *Hordheum vulgare*, heat wave, drought stress, antioxidant system, photosynthesis, growth

**WE348 Does elevated CO2 protects plants against heat waves damage?**

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The frequency and severity of heat waves is increasing as a result of climate change. Thorough investigations of extreme events are needed. The results of current study revealed an increased antioxidant response, oxidative damage, ROS production and energetic status, with increased activities of antioxidant enzymes (aquaculture and sewage). This effect is reflected by a physiological response of *D. chilenis*, 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 impact, climate 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 lowest pH values were during the high-flow seasons. The obtained results showed that 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.
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. Zaltanskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sujeto-Viene, A. Diksaityte, J. Januskaitiene, G. Kacien, G. Juozapasiene, D. Mikselyte, Vytautas Magnus University; S. Sakauskauskiene, J. Miliuskieniene, 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 its impact on 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. Differential responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the crop-herbicides interactions. 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 lambsquarter (Chenopedum 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 Chenopodium album and non-target H. vulgare plants, growing together in the microcosms in combination 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 responses of antioxidative defence system of both species were evaluated.

WE351  Combined effects of insecticide exposure and predation risk on freshwater detritivores A. Rodrigues, University of Aveiro / Biology Department and CESAM; M.D. Bordalo, University of Aveiro; O. Golovko, O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses; C. Barata, CSIC / Environmental Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Pestana, CESAM & University of Aveiro / Biology

Exposure to sub-lethal concentrations of insecticides are known to pose at risk non-target insects due to effects on physiology and behaviour. Under natural conditions, two main factors can influence the behaviour of 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 how the combined effects of toxicants and biotic stressors may affect populations, food web dynamics and ecosystem functioning. Chlorantraniliprole (CAB - 2,1) is an anthranilic diamide widely applied due to its specificity for insect 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 shredder 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 boltoni. A full factorial design tested the effects of the CAP (0 or 2 µg/L), presence/absence of the predator C. boltoni and of the shredder S. vittatum loss on responses of this species. Results show 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 chloromod 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 of 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 sulfentrazone) 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 metamorphosis expression of dioxin, cat, G6PDH and biotransformation enzymes activities 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 sulfentrazone or clomazone in R. schneideri and E. nattereri. Our results show that the temperature, herbicide, and their interaction (diuron and clomazone) 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. Differential responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the crop-herbicides interactions. 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 lambsquarter (Chenopedum 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 Chenopodium album and non-target H. vulgare plants, growing together in the microcosms in combination 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 responses of antioxidative defence system of both species were evaluated.

WE353  Adaptation vs. acclimation of natural phytoplankton communities towards herbicide exposure S. Rizzuto, Lancaster University / Lancaster Environment Centre; D. Bah, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / Lancaster Environment Centre; E. Leu, Akvaplanniva AS; L. Nizzetto, NIVA

Freshwater ecosystems are subject to natural and anthropogenic disturbances such as nutrient load, climate change, agriculture, toxicants and pollutants. Natural phytoplankton communities may also cause 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 sulfentrazone) on tadpoles of Lithobates catesbeianus. The levels and metamorphosis expression of dioxin, cat, G6PDH and biotransformation enzymes activities 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 sulfentrazone or clomazone in R. schneideri and E. nattereri. Our results show that the temperature, herbicide, and their interaction (diuron and clomazone) 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. Differential responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the crop-herbicides interactions. 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 lambsquarter (Chenopedum 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 Chenopodium album and non-target H. vulgare plants, growing together in the microcosms in combination 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 responses of antioxidative defence system of both species were evaluated.

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. Maltby, The University of Sheffield / Dpt. of Animal & Plant Sciences; S. Beulke, Envisearch / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology

Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active

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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 affecting 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 over a range of physico-chemical properties and uses, were modelled in rivers in 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 via suspect/nontarget screening

P. Naree, Changwon National University / Environmental Engineering; c. younggun, Changwon National University / FEED of Eco-Friendly Offshore Structure; J. Jeon, Changwon National University / Environmental Engineering Information on the occurrence and concentration of micropollutants 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 effluent 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-related indices. Thus, the risk analysis of the pollutants with high occurrence frequency and concentration have often been underestimated when their effect/toxicity are neither considerable nor well defined. In the present study, a list of prior effluent micropollutants is suggested with a exposure-index based scoring/ranking procedure following qualitative chemical analysis. A scoring table with exposure indices such as occurrence frequency and chromatographic peak area was applied for the ranking. WWTP effluent samples were taken in September, 2016 and analyzed via suspect/nontarget screening using LC-HRMS (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 micropollutants were orthogonally confirmed and roughly quantified. The quantified micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatories (acetaminophen, mefenamic acid), antibiotics/antifungal (climbazole, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazapine), antiestrogens (diphenyldiamine, fexofenadine), antihypertensive agent (ibersartan, valsartan), antiparasitic (acarbol, mepacrine), local anesthetic (lidocaine, procainamide), and the Antarctic copepod Tigriopus. The concentrations for the top ranker, acetaminophen detected in all 7 samples, was ranged up to 1.300 ng l-1. The 2nd ranking pollutant was caffeine and followed by cimetidine> mefenamic acid>fexofenadine>carbamazepine>ibersartan>fluconazole>dehydrocynamine> sulfamethoxazole. 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 expendable micropollutants 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 congenic copepods Tigriopus sp.

L. Hua, 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), 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 an exposure test lasting 2°C per day. In T. kingsejongensis, LT50 and NOEL were determined to be 28.4°C and 12°C, respectively. Levels of OS and GST activity were slightly elevated (<em>P</em>)

WE357 Effects of water bearing on zooplankton physiology and fitness driven by foraging characteristics in a long-term enclosure experiment

L. Minguez, 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 stressor 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 water flea 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 xenost characteristics and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water showed higher fitness than brown water daphnids. 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 expendable micropollutants which are worthy for intensive monitoring in effluents.
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 influencing 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 of the rotifer Brachionus sp. Cayman
L.G. Almeida, MARE - Marine and Environmental Sciences Centre / Instituto Politécnico de Leiria; C. Ferreira, Politechnic Institute of Leiria / Politechnic 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 & Artemia Reference Center; C.C. Novais, Universidade de Aveiro / IAPREM; F. de Laender, Universiteit Gent / Laboratory of Aquaculture & Artemia Reference Center; K. Nott, Société Nott Ind. Farma & Cons. / Research Unit in Biotechnology; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; J. Porcher, INERIS / INERIS WE361

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 production. 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 test if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural and artificial stressors in life stages and early life toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cayman (MRS10 and IB3), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artemia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25ºC and 25ºC and 25ºC and 25ºC 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. Results showed 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 aquaculture 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 Nott Ind. Farma & Cons. / Research Unit in Biotechnology; H. QUEAU, N. Delorme, Institut Lyon ONR / MALY Laboratoire Ecotoxicologie; K. Kossey, Université de Liège UL; P. Baudoin, C. TURIES, INERIS-UMIR SEBIO ECOT; A. Catteau, A. Bado-Nilles, INERIS; M. Fourage, Unamur; O. Geffard, Institut Lyon ONR / MALY Laboratoire Ecotoxicologie; J. Porcher, INERIS-UMIR SEBIO ECOT; A. Geffard, 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 providers import valuable services which leads to a strong societal demand concerning the preservation of their quality. They are the receptors of many contaminants emitted by human activities and more specifically, by Polywaste treatment plants effluents. Water resources of the Meuse watershed are used on both sides of the French-Belgian border which involves a coherent and joint management. In that framework, the DIADeM project suggests developing and spreading out a cross-border multidisciplinary approach to improve the diagnosis and the chemical and biological (biomarkers) monitoring of freshwater providers using the Meuse river as a case study. In the past, results from chemical surface water monitoring of the Meuse has revealed the occurrence of numerous substances and more particularly pharmaceuticals. Overall, the project suggests coupling chemical and biomarkers analysis on caged organisms (a crustacean, a mollusk, a moss and a fish species) with predictive mathematical population models. In order to calibrate and validate these models, a lotic mesocosm experiment was set up. Five substances were chosen: diclofenac, carbamazepine, naproxen, paracetamol and ibresartan. An environmental realistic mixture M of the five substances was tested along with MX10 and MX100. The study was carried out in twelve 20 m long lotic channels. The mesocosms were set up with artificial sediments, macrophytes, periphyton, benthic and pelagic invertebrates decomposers and one fish species (Gasterosteus aculeatus), zebra mussels, Fontinalis antipyretica and Gammarus fossarum were also caged in the mesocosms. After 3 months of stabilization, treatment lasted 5 months. Periphyton biomass, macrophyte biovolume, zebra mussel biomarkers and growth, G. fossarum survival, reproduction and growth, F. antipyretica biomarkers and growth, zooplankton and invertebrate abundance and diversity, and fish individual physiological responses to stressors were measured and measured biological endpoints. The concentrations of each substance in water was monitored monthly along with some physico-chemical parameters. The overall experimental design will be presented along with the results related to the monitoring of substance concentrations in water, physico-chemical parameters, macrophyte biomarkers, invertebrate community response, fish larval densities. A brief discussion of the direct and/or indirect effects will then be performed.

Improving the Quality of Ecotoxicological Testing and Assessment (P)

WE362  Relationships between aquatic toxicity, chemical hydrophobicity and mode of action: log-kow QSRs revisited

Quantitative structure toxicity relationships (QSRs) 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 classifications. Log kow-QSOAR classifications were developed using linear regression 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, ionomosomregulatory/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 QSR 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 reproducibility of effects. In addition to the exposure 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 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 (SSD) for use in pesticide risk assessment
L. Azavedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; S. Zenses, 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: HCs vs NOEC design
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 where a limited number of rates was tested in a replicated block design and the NOEC endpoint was found via statistical hypothesis testing. The merits 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 analyze whether “No Effects” may have statistical or biological causes. In the HC-design consistent dose-response curves were obtained within 4 major arthropod taxa (76% 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 univariable 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 dose-response curves 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 will 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 ECα, is the most straightforward to assess within studies of pest control challenges where a damaged area is the focus 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 ECβ-findings 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. A risk of ∝ is known as a Type-I error that is related to the test statistic x, where frequencies ∝ and β, respectively. This contribution challenges the dominance of ∝ and underscores the prominence of β 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> ∝) is interpreted biologically and statistically valid results where the producer’s risk is low. Safety stems from rejecting the null hypothesis when false and therefore the complement of ∝ is known as the power of an experiment. We show how power criteria can be derived and used to construct a biology based confidence profile for studies addressing NTA communities. We also show how relaxing ∝ helps to identify those taxa for which an experiment does not provide sufficient conclusive data to draw meaningful conclusions. In a multi-rate study design, the proposed increase of ∝ to 10% is shown to be off-set by applying expert criteria such as inconsistencies or dose in time.

WE368
Defining simple toxicity values (EC, BMD) is not so simple
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Effective Concentrations (ECs) have now largely supplanted No Observed Effect Concentrations (NOEC), after decades of statistical criticisms towards the latter. ECs has a simple definition which sounds unambiguous. However, depending on the concentration-response pattern, its derivation is not trivial and should be paid attention in the context of ecotoxicological risk assessment. We recently developed a workflow for high-throughput concentration-response modelling of omics data (e.g. transcriptomics, metabolomics). Such data often displayed non-monotonic trends (U or Umbrella shape) as well as linear and exponential trends. According our results, sigmoidal concentration-response shape was more the exception than the rule, as also reported in the literature for such omics 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 makes 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) approach has been proposed in the ecotoxicology 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 hazardously 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
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 an NOEC is not given unless a null model assumption is used. 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 samples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE371
SETAC Europe 28th Annual Meeting Abstract Book
Deriving no effect levels using probabilistic approaches: Application to trichloroethylene (TCE) and potential impacts to risk-based exposure concentrations

N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; B. Magee, S. Sager, ARCADIS US Inc

Derived no effect levels (DNELs) are indispensable tools needed to quantitatively evaluate the probability of adverse chemical exposures to humans and inform decisions related to exposure mitigation and environmental remediation. Typically, DNELs are calculated using deterministic methods that rely on single point estimates of no-effect levels, assessment factors (AFs) that allow extrapolation to human exposure scenarios and account for uncertainties in toxicological information, and allowable risk level. However, the point estimates used to calculate DNELs are by definition conservative estimates that when combined lead to a phenomenon termed “compound conservatism”. The consequence of this phenomenon is DNELs that likely overestimate potential risks associated with human exposure to chemicals. Probabilistic risk assessment (PRA) approaches can be used to characterize the level of conservatism in deterministically-derived DNELs and to directly calculate DNELs. The advantage of calculating DNELs using PRA approaches is the incorporation of all available data and information that is associated with the particular input variable (i.e., variability amongst 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 protectiveness of a chemical’s DNEL. 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.

WE372 Aquatic higher-tier exposure testing of pesticides - from complexity to simplicity

G. Eck, E. Eschenbach, Eurofins Regulatory AG

Future 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 conditions that are 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 an efficient testing and to align these generic patterns with sensitive life stages of the organisms of concern. Practical aspects, types of effects and life traits of test organisms add to the complexity of designing reasonable higher-tier exposure studies. The challenge is to balance representativeness and practicability of test designs. Representativeness can for example be enhanced by multi-year modelling simulations where the variability of treatment and climate constellations are taken into account. Detailed analysis of the multitude of predicted exposure scenarios as well as a detailed analysis of available standard toxicity data is required to develop meaningful test designs and strategies. Generating simplicity from complexity rather than matching exactly the FOCUS modelling exposure pattern is proposed as potential solution to concerns on representativeness as well as practicability for ecotoxicology testing and finally acceptability in a regulatory context. The poster will present examples for the generation of reasonable test designs and strategies that are considered to meet objections towards higher-tier exposure testing as adequate means for refinement of aquatic risk.

WE373 Keeping it real: multidisciplinary approaches to aquatic risk assessment


Aquatic risk assessments for plant protection products (PPPs) can often be complex, comprising multiple crops, application rates, Member States (MSs) and therefore require high-cost critical scenarios to cover the fact that hazard quotient (PEC/PNEC ratio) really represents and whether it is a realistic representation of the true 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 realistic estimations of risk. For example, assessment of the exposure profile 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 Ecutox GmbH; U. Mennem, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurofins Agroscience Ecutox GmbH / Aquatic Ecotoxicology

Aquatic exposure testing: The aim is to achieve higher-tier risk evaluations proposed in the current EFSA guidance document for aquatic risk assessments for 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 is proposed in the current EFSA guidance document for aquatic risk assessments for protection products. 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, F0) 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. More pertinent application of the results was commonly 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 (PEC\textsubscript{a/a}, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT\textsubscript{50} 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.

WE375 Repeated pulsed exposure in a partial life cycle test with zebrafish: Keep it realistic!

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Refined exposure tests can be used to transfer more realism into standardised aquatic exposure testing. The aim is to achieve 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, F0) 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. More pertinent application of the results was commonly 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 (PEC\textsubscript{a/a}, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT\textsubscript{50} 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.
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.
T. Lancher, C. DUPUY, A. Jourdan, Groupe SGS France; I. 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 HOCfE guideline, for example. The embryo and larval stage sensitivity of turbot (Scophthalmus maximus) to daphnia and another test substance were studied. 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 oyster larvae 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. Dammann, S. Champ, BASF SE; M. Mathis, P. Fort, 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 (N&F) stages X Xenopus laevis larvae to different exposure methods of 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 axis disruption. Recently, the relevance of suitability of hindlimb length 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 (r²=0.315-0.275, 0.553). Negative or no correlation between hindlimb length and body weight of 6 of the 7 studies with asynchronous late stage development (r²=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 (r²=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
WE382 Introduction of a New Dosing System for Chronic Fish Tests Conducted with Difficult Substances
S. Höger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Peither, Innovative Environmental Services IES Ltd
Chronic toxicity tests with fish are required for the risk assessment of plant protection products, pharmaceuticals and chemicals (depending on their damage and characteristics of the chemical). 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 full life cycle test. 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 is detected. New technology evaluating Acartia tonsa as a biological model

WE385 New Technology evaluating Acartia tonsa as a biological model
S. Abreu, University of Aveiro / Dep. 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 / DEIT / IEETA
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 is the time consumption procedures related with counting and cultures monitoring. To overcome such constrain, the aim of the present study was to evaluate the application feasibility of a new technology based on automatic counting and classification of live copepods into different size classes and/or organisms. 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 indicates a high significant correlation between manual and automatic counting, constituting the first step for the use of this biological model on experimental studies.

WE386 Solubility limits of lanthanides in standardized ecotoxicological media
S. Barth, K. Voigt, H.-J. Borchardt, W. Römbke, Römbke, J., Schmelz, R., Knaube, 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:

WE384 Activity based Collombola sampling may improve the data of field studies for regulatory purposes
B. Mack, A. Appeltauer, J. Illig, Eurofins Agrofins Services Ecotom GmbH / EAS Ecotox GmbH / Ecotox Field

WE383 Difficult Substances as Challenge for the Algal Growth Inhibition Test According to OECD Test Guideline 201
S. Höger, 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 hints how the “standard test items” with difficult test conditions should be conducted, but due to the numberless combinations of characteristics of these different 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, degradation, storage conditions). Dosing. In this respect, the OECD 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, 193). 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/IEC 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories nanoexposed 24h-48h (after the regurgitation case) and meso bass larvae (50-70 days old) to the toxicant referent (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±1.03 mg/L to 48h, respectively. The intra and inter laboratory variability of the tests were verified and Z statistics 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.

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The necessity to develop appropriate methods for the assessment of water quality and effluent toxicity was recognized by environment protection organisations and indicated by legislative bodies, the 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, 193). 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/IEC 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories nanoexposed 24h-48h (after the regurgitation case) and meso bass larvae (50-70 days old) to the toxicant referent (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±1.03 mg/L to 48h, respectively. The intra and inter laboratory variability of the tests were verified and Z statistics 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.

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Improving ecotoxicity tests for trace elements forming poorly soluble chemical species in test media

D.A. Vignati, CNRS / LIEC UMR7360; C. Hisler, Luxembourg Institute of Science and Technology; J.E. Groenenberg, Université de Lorraine and CNRS / LIEC UMR7360; C. Cosso-Leguille, Université de Lorraine; L. Giamberrini, Université de Lorraine, CNRS UMR 7360 / LIEC, CNRS

The biogeochemical cycles of several lanthanides (LNs) are being progressively disrupted by their increasing use in industrial sectors such high-tech applications and clean energy generation. Except for a few hotspots located close to these industrial waste deposition sites, LNs concentrations remain essentially low (i.e., in the µg/L range or lower), but the paucity of available data has fostered research on their possible effects on biological organisms. Getting reliable information on the ecotoxicological potential of LNs is also important in view of the possible (re)opening of mining activities in response to the current monopoly of LN production by the People’s Republic of China. In this context, testing LN ecotoxicity following established standard protocols must consider the peculiar chemistry of these elements if meaningful results are to be obtained and used to establish regulatory limits. After addition to ecotoxicological media, typically in the form of solution aged for 4h and 72h which, based on previous research, would be long enough to ensure LN concentration homogeneity and reach eventual LN solubility and reduce to a fraction of the expected value the concentrations to which organisms are exposed. The presence of possible LN-containing precipitates can further complicate the interpretation of the corresponding biological responses. In this contribution, we use thermodynamic speciation modeling to examine the equilibrium theoretical speciation of LN in standardized ecotoxicological media for all LNs, together with speciation patterns for (re)opening of mining activities in response to the current monopoly of LN production by the People’s Republic of China. In this context, testing LN ecotoxicity following established standard protocols must consider the peculiar chemistry of these elements if meaningful results are to be obtained and used to establish regulatory limits. After addition to ecotoxicological media, typically in the form of solution aged for 4h and 72h which, based on previous research, would be long enough to ensure LN concentration homogeneity and reach eventual LN solubility and reduce to a fraction of the expected value the concentrations to which organisms are exposed. The presence of possible LN-containing precipitates can further complicate the interpretation of the corresponding biological responses. In this contribution, we use thermodynamic speciation modeling to examine the equilibrium theoretical speciation of LN in standardized ecotoxicological media for all LNs, together with speciation patterns for

WE387
Improving ecotoxicity tests for trace elements forming poorly soluble chemical species in test media

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In order to get an appropriate interpretation of ecotoxicological results the exposure concentrations of test organisms to the contaminant of concern must be kept constant and stable over the test duration. Increasing evidence suggests that this is not always the case when dealing with elements that tend to form chemical species with low solubility (e.g., oxides and oxyhydroxides for Cr(III) and some LNs; colloidal/particulate species to biological effects by testing the ecotoxicity of solutions aged for 4h and 72h which, based on previous research, would be long enough to ensure LN concentration homogeneity and reach eventual LN solubility and reduce to a fraction of the expected value the concentrations to which organisms are exposed. The presence of possible LN-containing precipitates can further complicate the interpretation of the corresponding biological responses. In this contribution, we use thermodynamic speciation modeling to examine the equilibrium theoretical speciation of LN in standardized ecotoxicological media for all LNs, together with speciation patterns for

WE389
Is that an effect? The importance of using all relevant data in mesocosm studies

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In long-term multispecies studies, such as mesocosms, a complex statistical analysis is required to decipher the data and determine whether a test-item effect has occurred. It is sometimes the case that regulators and applicants have differing opinions as to what the no observed effect concentration (NOEC) or no observed adverse effect concentration (NOAEC) should be, based on the accompanying data analysis. This expectation was because 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, colonisers and experimentally added species. Each of these methods captures a particular species; sweep nets are used to capture fast-moving pelagic organisms whereas colonisers are left in-situ to allow benthic organisms to enter the trap. In some cases, the same species can be caught using different sampling methods, such as mayflies, damselflies and caddisflies, and this can be from various stages in their life cycle. Comparing the data for the same taxa from different sampling methods can be helpful in creating and overall picture of how that taxa is responding within the mesocosm study. This can be helpful in deciding whether statistically significant differences are biologically relevant; for example, if a statistically significant difference to the control is only observed in one out of three sampling methods used for a particular taxa, this may indicate this is due to natural variation rather than an influence of the test item. Here, we will evaluate daphnia, dace, dace and dace from past CEA studies where statistically significant differences have been observed and highlight cases where different sampling methods (emergent, colonisers and sweep nets) support or contradict a test-item effect.

WE390
Evaluation of the environmental risk assessment procedure according to Directive 2001/18/EC for Gene Modified Organisms used as medicinal products

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The deliberate release of genetically modified organisms (GMOS) including GMOS...
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) contains information about all GMOs undergoing application in the EU. 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.** The enterprise, 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 here as a measure of safety. Most of the data from a set of chemicals known as highly hazardous for the environment. Such data from a set of chemicals known as highly hazardous for the environment. Such data were originally designated. The numerical criteria were established Whether a chronic value can be established based on its MoA. Significant scientific progress: For which PBT evaluation 20 years on: is it time to reconsider the technical progress up to date versions of the exposure models SimpleTreat and SimpleBox, combined with state-of-art expected mixture pressure calculation using the Van Straalen-Aldenberg convolution integral. The tool estimates the addition of toxic pressure to the ambient toxic pressures in local, regional and continental EU environments, expected from the UVCB mixture. It is proposed that ‘safe use’ is demonstrated sufficiently well by showing that the UVCB under study is expected to contribute negligibly to ambient toxic pressure in the environment. The proposed ‘safe use’ calculation method has been tested in a number of cases relatively well studied UVCBs. In the poster briefly explains the new UVCB block method and illustrates its potential with the outcomes of test calculations.

### WE393 Evaluation of hypohypharyngeal glands development in Honeybees (Apis mellifera L.) from toxicity studies in the light of current guidelines (EFSA and OECD)


**Honey Bee (Apis mellifera L.) is a species that belongs to a group called ‘beneficial insects’. All arthropods from this group play the important roles in nature, albeit bees go a few steps forward and they also find application in the food, pharmaceutical and others industries. With the current decline in bee colony numbers, these arthropods should be handled with extreme caution. Therefore, it is extremely important to assess the risk for non-target organisms for which plant protection products are often more toxic than pests of agricultural crops. This assessment is related not only to the direct influence of chemicals on the bee populations, causing morphological mortality or morbidity, but also indirectly - through the impairment of the ability to raise the larvae, for example by disturbing the work of hypohypharyngeal glands (HPG) responsible for the production of ‘milk’ containing proteinous substances to seed larvae and queen. By 2017, the only document regulating the toxicity study of chemicals on bees was the EFSA document (EFSA Journal 2013;11(7):3295), which included continuous access to distilled water and pollen and evaluation of HPG. However, in 2017, the new OECD guideline (no. 245) was introduced, in which the methodology of chronic toxicity testing was changed compared to the EFSA document. Changes occurred in the way of dealing with bees – there is no access to distilled water and pollen, and no evaluation of HPG. It is a significant change, because according to the literature many bee studies, hypopharyngeal glands do not develop correctly in these Institute conditions, which exclude the assessment of HPG. Hence OECD guideline probably does not consider it as endpoint in the study. As previous study has shown, chemicals can have influence on development of hypohypharyngeal glands, without causing mortality and morbidity. This matter is worthy considering and should be investigated further, in order to introduce the evaluation of hypohypharyngeal glands as an endpoint in toxicity testing of chemicals on bees.**

### WE394 Assessing toxicity to *Daphnia magna* using movement parameters

Planktonic invertebrates show high sensitivity to various toxicants, therefore representing a useful model organism in ecotoxicological research – with common endpoints being survival, reproductive success and observable morphological changes. Some of recently conducted scientific investigation involving these organisms focused on examining the effects of various substances on their mobility. The aim of this work was to compare and examine the changes of swimming behaviour of *Daphnia* over time and under the influence of sub-lethal concentrations of ZnCl₂, based on 12 chosen movement parameters. Organisms obtained from a natural habitat acclimatized to laboratory conditions were exposed to various sub-lethal concentrations of ZnCl₂. The video recordings were placed in each transparent plastic Petri dish in prepared solutions of the selected toxicant. The recording started instantly upon exposure of the organisms to the toxicant (t₀), as well as 1 h, 2 h and 48 h of exposure (dt=1 h, dt=24 h, dt=48 h). The recording and analysis of motion were carried out in Python, implementing OpenCV, TrackPy and NumPy packages. Analysis of the obtained data showed that the duration of exposure affects the movement parameters, regardless of the concentration of the toxicant. Although, some of movement parameters showed significant correlation with concentrations of toxicants and hence can be used as an early biomarker of exposure.

### WE395 The validation of analytical methods in ecotoxicology

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The validation of analytical methods (regulated by SANCO/30299/rev 4.) used in support of ecotoxicological studies has become an important aspect of the
registration process for plant protection products. When Regulation (EC) No. 1107/2009 came into force, adherence to the SANCO/3029/99 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 EFSA Aquatic Guidance 2013
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Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. EFSA 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 in 720 ml of water. 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 different 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 current 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 in nanoparticulate form has broadened the range of applications, both in large scale, e.g. as anti-stick agent in food industry, or to its abrasive effect in cosmetics; and in small scale, for the production of biosensors, swim-up fry. There were two 22 hour stages [1]. The use of silica nanoparticle (SiO2-NPs) as a delivery vehicle for molecules in plants is being investigated [2], demonstrating their potential in environmental applications. Many of the current uses increase the likelihood that SiO2-NPs could accumulate in the environment and in food webs. Therefore, it is crucial to investigate the dissolution of SiO2-NPs in different environments. Besides information about the degradability of the nanomaterials, 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 quantitation and the parallel characterisation of the particles by transmission electron microscopy (TEM) and dynamic light scattering (DLS). A simple setup based on diode laser 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] Barik 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 fullerene aggregates in Mediterranean rivers: Two cases of study
J. Sanchis, IDAEA-CSIC / Water and Soil Quality Research Group; R. Milacic, 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 aquatic studies. This method relies on the use of inductively coupled plasma optical emission spectroscopy (ICP-OES) for the quantification and the parallel characterisation of the particles by transmission electron microscopy (TEM) and dynamic light scattering (DLS). A simple setup based on diode laser 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] Barik 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.

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WE400
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The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

M. Surese, 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 ecosystems has been the focus of much 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 ENMs' engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. In 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 tracked, and the attachment efficiency was calculated. The attachment efficiency of ENMs in aquatic and terrestrial environments has been suggested to negatively impact ENMs' stability. However, the details of the mechanisms involved in the removal of ENPs from wastewater are not well understood. The removal kinetic and efficiency during activated sludge stage. V. Cappadona, 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, medicine, and catalysis. As the technology grows, so do the potential negative impacts of ENPs on the environment. In this work, we explored the potential for ENPs to negatively impact aquatic ecosystems. Using samples of a local freshwater river to represent a complex, natural medium, we found that ENPs did not significantly impact aquatic ecosystems. However, this work also highlighted the need for further research in this area.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage. Y. Crespo, University of Barcelona / Environmental Engineering; C. M. Sendra, University of Barcelona / Environmental Engineering; M. Sendra, University of Barcelona / Environmental Engineering; C. M. Sendra, University of Barcelona / Environmental Engineering; C. M. Sendra, University of Barcelona / Environmental Engineering; C. M. Sendra, University of Barcelona / Environmental Engineering

Engineered Nanoparticles in wastewater treatment plants (WWTPs) are of increasing concern due to their potential to negatively impact aquatic ecosystems. In this work, we investigated the removal kinetic and efficiency of ENPs during activated sludge treatment. Using a simplified, synthetic medium, we found that ENPs were removed from the wastewater stream through sedimentation and adsorption. However, the efficiency of ENP removal was dependent on the type and concentration of ENPs. The results of this work have implications for the design and operation of WWTPs, as well as for the development of new ENP removal technologies.

WE402 Fate factor of engineered TiO2 nanoparticles in aquatic and terrestrial natural environments

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Nanoparticles are defined as nano-objects between 1 and 100 nanometers in size. Engineered TiO2 nanoparticles are used in various fields such as construction, cosmetic and food which leads to an important production and inevitably to emissions generating environmental impacts. To quantify them, the Life Cycle Assessment offers a powerful method that is able to characterize TiO2 ENPs according to their fate in environmental media and their effects on ecosystems and human health. The main objective of this study is to determine the engineered TiO2 nanoparticles (TiO2 ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO2 ENPs in water, soil and sediment near a production site in Vieux-Thann (68) to determine parameters which could be used in the TiO2 ENPs fate model and secondly to determine parameters which could be used in the TiO2 ENPs fate model. In this work, we investigated the fate of TiO2 ENPs in aquatic and terrestrial environments. We found that TiO2 ENPs were removed from the environment by sedimentation and adsorption. The results of this work have implications for the design and operation of WWTPs, as well as for the development of new ENP removal technologies.
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 effect 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 leading to NPs uptake, bioaccumulation and toxicity in different organelles. Therefore, the hypothesis of this work is that microalgae lacking of cell wall will be more susceptible to the toxic effects of NPs than those with a typical cell wall. To test this hypothesis two microalgae species, Dunaliella salina, lacking cell wall, and Chlorella autotrophica, with a typical cellulosic cell wall were chosen. Species were exposed to ionic (Ag(NO₃)₂ 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 marine 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 seems 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 (COOH and HKUST), 8 µm (HKUST), Zn-CPO, 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 NPs 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 (COOH and HKUST) up to 8 µm (HKUST), Zn-CPO and CPO-27-Ni had the most negative zeta-potential of -25 and -20 mV respectively, with Al(OH) femurate and FeBTC-JM-AR featuring a positive surface charge. UlO-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 membrane conductance, hence increased cell leakage, both directly after dispersion preparation and after a 72 h incubation period, reflecting the duration of an R. subcapitata standard toxicity test. Most notable releases after 72 h were from Zn-CPO (Zn, 3457 µg/L), CPO-27-Ni (Ni, 235 µg/L) and HKUST (Cu, 143 µg/L). UlO-66-COOH caused a 100 % increase in S in the exposure media, while Al(OH) femurate caused an increase of Al from 11 mg/L to around 60 mg/L. FeBTC-JM-AR was the most inert material regarding release of dissolved metals. Due to their adsorption properties, the materials also drastically reduced the amount of P in the exposure media, with UlO-66-COOH also decreasing Ca and Mn. Potential mode-of-actions, i.e. impact of NPM particles through depletion of nutrient elements, toxicity of dissolved metals, or effects from organic components will be identified in the R. subcapitata toxicity tests.

WE408 Tracking Physicochemical Changes of PAHs in the Presence of TiO₂ Nanoparticles by Assessment of Biological Responses

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Polycyclic aromatic hydrocarbons (PAHs) are a class of persistent environmental contaminants with diverse physicochemistry and toxicity. In contaminated aquatic environments, PAHs frequently accumulate in sediments or are sorbed to particulates in the aqueous phase. Some PAHs are phototoxic and have photo-induced toxicity, but little is known about interactions between PAH phototoxicity, sorption, environmental fate, and toxicity. Engineered nanoparticles (NPs) can behave as particle agglomerates that participate in sorption/desorption reactions in the aqueous phase, and some NPs (e.g., TiO₂-NPs) also have phototoxicity. 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 exposure 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 (cytotoxicity P4501A cyplA gene expression in larval zebrafish) is used as an analytical tool to demonstrate sorption of antracene and benzo[a]pyrene to NPs in water. Our objective is to investigate PAH/TiO₂-NP sorption under UV-A and sunlight. In the first step, we analyse the immobilisation of PAHs on polycyclic aromatic hydrocarbons (OPAHs) on NPs. Various combinations of PAH/TiO₂-NP preparations will be exposed to UVA, and changes in gene expression of genes involved in Phase I metabolism (cytosome P450 cyplA and cyplB) and Phase II metabolism (gst, epox; gsh; and epoxide hydrolases ephxl and ephlx2) in early life stages of zebrafish will be assessed. The exploitation of biological responses in PAH/TiO₂-NP systems is expected to reveal if the product bioavailability during sorption processes will provide novel insight into these processes tested directly within the environmentally relevant aqueous phase.

WE407 Toxicity of TiO₂ nanoparticles to freshwater chironomids - pointing out the relevant endpoints

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Inorganic-organic hybrid nanoporous materials (NPMs), such as amorphous mesoporous aluminosilicates and Metal-Organic Frameworks (MOFs) are designed and developed for numerous applications including health care, industrial cooling systems, air purification and gas storage. Their usage and production is expected to increase significantly within the next years, with new applications such carbon capture and storage becoming increasingly important. In this study, we investigate the environmental behaviour of 6 NPMs and determine their toxicity towards the freshwater algae Raphidocelis subcapitata. The size, surface charge and dispersion stability of NPMs of both forms (NPs and ionic) were determined using dynamic light scattering. The morphometric analysis performed on microalgae was reflected in the results obtained in their growth experiments. Chlorella autotrophica, lacking cell wall, was the most sensitive to Ag, and Al(OH)₂NPs were the most active NPs promoting photo decomposition of PAHs 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 (cytosome P450 cyplA and cyplB) and Phase II metabolism (gst, epox; gsh; and epoxide hydrolases ephxl and ephlx2) in early life stages of zebrafish will be assessed. The exploitation of biological responses in PAH/TiO₂-NP systems is expected to reveal if the product bioavailability during sorption processes will provide novel insight 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 Grxl-roGFP2, 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 monitoring the root surface area of Arabidopsis thaliana exposed to AgNPs. 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 toxicants. Acknowledgements: Karl Andreas Jensen and Sofridur Lohn. This work was supported by the Norwegian Research Council funded NanoCharm (22139/IE40) 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. Keuk, 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) was selected as a test nanoparticle due to their different exposure, however, these were considered: 1) control, 2) layer of AgNPs with low concentration (Low-Layer), 3) layer of AgNPs with high concentration (High-Layer), and 4) mixture of AgNPs and soil with low concentration (Low-Mix). Plant microcosm experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because the root surface area was biggest in AgNPs-exposed than Lower-Layer and High-Layer. In case of soil enzymes, activities were depended on exposure concentration. This study concluded that exposure concentration of nanomaterials as well as depth of nanomaterials layer should be considered in the soil ecotoxicity research area. 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 (2016R1A2B4010445).

WE410 Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight Y. Seong, 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 size of microplastics was quantitatively determined. In the previous study, fragmentation of nano- and micro-sized plastics was qualitatively and quantitatively determined from the expanded polystyrene (EPS) exposed to sunlight for 9 months. The exposed EPS cubes (3x3cm surface area) were sampled into 3 exposure groups at 2, 5, and 9 month exposure duration. The root surface colour was changed from white to dark yellow during exposure. The fragmented particles at the top surface of each cube directly exposed to sunlight were collected in 2 ml solution consisting of HPLC grade pure water with 0.1% acetic acid, and were filtered under < 50 µm size filter paper. The mass of >10 µm particles produced per EPS cube surface area (g/m²) significantly (p<0.05) increased according to exposure time: 0.1±0.1 g/m² for control, 2.6±0.3 g/m² for 2M, 3.9±0.4 g/m² for 5M and 7±0.2 g/m² for 9M. The mean and median size of >10 µm EPS particles measured by laser diffraction was 26-29 µm and 18-20 µm, respectively. The hydrodynamic diameter of the EPS particles in the filtrates of < 0.2 µm pore filter was 32 nm for 2M, 530 nm for 5M and 752 nm for 9M by dynamic laser scattering. Their particle abundances measured by nanoparticle tracking analysis were 1.8x10¹⁵ particles/ml for 2M and 3.2x10¹⁵ particles/ml for 2M and 9M. Two month exposure of EPS to sunlight was enough to produce a large number of micro- as well as nano-sized plastics by surface weathering.

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 would include plastics to the total pool of suspended particulate material. Studies in this section describe 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 particles collected from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres. Analysis of the nano-MS particles generated by barcoded 16S rDNA gene MiSeq sequencing revealed that the addition of nano-plastics introduced some minor variability within treatments, with respect to microbial composition. The presence of the nano-plastics marginally increased the α-diversity of the community associated with the particles, compared to the community associated with MS in the absence of nano-plastics. Statistical analysis, 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 nano-plastics) MS particles. The environmental conditions suggest that plastic debris and marine snow are a major influence in altering the bacterial communities associated with MS particles.

WE412 Tracking nanoparticles in marine bivalves at environmentally realistic concentrations M. AL SID 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 fate and impacts of plastic particles as their size 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 a part per million. It is not clear how plastic debris and marine snow would include plastics to the total pool of suspended particulate material.


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 microplastics, which can be denominated as micro- (<1 mm) or nano-plastics (<100 nm) depending on size distribution. 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 toxicity 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 Similarly

Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposit 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 types of perturbations caused by interactions between the intestinal and the plethora of environmental variables that affect the fate and toxicity of ENMs over various spatial and temporal scales. In this context, an overview is given on recent achievements in assessing nano-specific effects on systems varying in physico-chemical and biological complexity. Amongst others, it will be illustrated how ENM toxicity can be affected by the intrinsic physico-chemical characteristics of ENMs (e.g. size, shape, surface charge, coating) and extrinsic environmental characteristics (e.g. NOM, pH, electrolytes) and how ENMs interact with various components of food webs. ENMs in the environment may directly or indirectly affect a diverse array of organisms and microorganisms, which likely cascade towards distorted ecosystem processes. We further identify challenging yet promising research areas in this emerging field that are essential in pursuing a realistic risk assessment that accounts for ecosystem complexity and functioning.

The take home message is that there is a need of studies assessing not only impacts of ENMs on single species but also a need of a comprehensive framework of nano-specific toxicity in complex ecosystems. Considering the abiotic complexity of the transport of ENMs in the natural environment, studies performed with laboratory-cultured species need to include proper characterization and systematic quantification of the environmental factors that impact fate and effects of ENMs. In addition, the biotic complexity in the ecosystem especially in the aquatic and terrestrial 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 invertebrates 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, Kitche / 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 river and raised spot of a road and reduced speed. Vibration vulnerability assessment was 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 supplying system with 5.5kW AEW and 12kW 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**

Trophiic 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 Engineering; 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 biogeochemical processes and trophic interactions 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 (Esox lucius) accumulated Ag in their tissues. The greatest bioaccumulation was observed in the liver tissues of pike, and a significantly larger amount of Ag was concentrated in the liver tissue of Ag feed pike (9.5 ± 0.5 mg kg⁻¹ 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⁻¹. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through uptake into the gill, whereas Ag uptake into Ag feed 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 3 orders of magnitude greater than the concentrations in water.

**WE417**

Hepatotoxicity of iron oxide (magnetite) nanoparticles in the guppy Poecilia reticulata

G. Qualhato, Federal University of Goias / Department of Morphology; T.L. Rocha, University of Algarve / CIMA; S.M. Saboia-Morais, Federal University of Goias / Department of Morphology

Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomedication, its toxic effects to aquatic organisms 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 have 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 frequency of histopathological changes in fish after the 7 days of exposure to IONPs, such micro- and macro-steatosis, melanomacrophages 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 focii 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

**WE418**

Bioavailability of silver (Ag) in different size fractions of Ag(I) in aquatic systems

B. Vliegenthart, VITO / ABS; e. rossi, OVAM; G. vanermen, VITO; K. Tirez, Flemish Institute for Technological Research VITO

In the study presented here we benchmarked biotest results against waste materials with the chemical characteristics (substances labeled H400, H410, H411, H420) are compared to defined limit values fr (step 1) and it was conclusion that LID4 as TE was a suitable option for our data set. The main conclusions were: The proposed set 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 OVAM, the Flemish Waste Agency/ The kind help of the technicians Guy Geuskens, Cis Boonen, Wilfried Dumortier is highly appreciated.

WE419
What is the future for the waste wood in terms of ecotoxicological testing? S. Legay, FCBA / Chemystry 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 contaminant 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: Eco-toxicity 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/biochemical 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, e.g. 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 lowest and highest 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. viridissimus > R. subcapitata > C. vulpina > 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 pursued.

WE421
Chemical and Ecotoxicological Assessment of Reclaimed Asphalt for their Subsequent Use V. Janbor, M. Buckova, R. Lichinsky, J. Hegrova, J. Huzlik, K. Effenberger, 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 carried 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 N. Bandow, Federal Institute for Materials Research and Testing / Contaminant Transfer and Environmental Technologies; F. Jürgens, BAM Federal Institute Materials Research and Testing; U. Schoknecht, BAM Federal Institute for Materials Research and Testing 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 compared to limit values given in environmental regulations. Further, considerations are necessary including exposure scenarios and environmental pathways before leaching tests 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. Dryzinowski, Texas Tech University / Department of Civil Environmental and Construction Engineering; J. G. Pitt, The University of Alabama; E. Strecker, B. Steets, M. Otto, Geosyntec 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 Paleta 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 methods 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 lead to sediment recontamination in the near field of the receiving water (e.g., PAH, and Cd). Cu was associated to the dissolved and clay fraction, however the depositing loads were more influenced by resuspension and redistribution of sediment than stormwater. Data suggested that PAHs and PCBs, due to low bioavailability as determined with passive sampling and bioaccumulation testing, are not a strong contributor to sediment toxicity which appeared to be better correlated to the presence of other heavy metals in the tracers. This indicated that the 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. Heil, Norwegian Geotechnical Institute; P. di palma, IRSSACNR; C. Riccardi, INAIL; E. Erik, 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) Carbonatia, 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 polyethylene glycol (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 polydimethylsioxane (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 organoacy. For example, antracene porewater concentrations in the first centimetre of capping material, were reduced by 69%, 56% and 99% respectively for activated carbon, organoacyl 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 were measured as indicators that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**WE425**

**Polychlorinated biphenyls (PCBs) 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, RBL / 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 were developed and evaluated in a pilot 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 sediments. Previous studies and observations indicated that PCBs, including 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. Bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured to determine 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 then retrieve the sediment and exposed organisms for chemical analyses was a challenge. Modifying a chamber design used in previous studies by Luby et al. (2009) proved successful.

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 characterizations, 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 bioavailability and risk of exposure. Survival of E. crypticus exposed to mine waste water solutions in an inert quartz sand matrix was assessed for 21 days. PCB tissue concentrations in different sorbent materials (AC, OC and BC) were measured as indicators of remedy effectiveness. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured to determine that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments. The bioavailable concentration was assessed by using polyethylene glycol (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 polydimethylsioxane (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 organoacy. For example, antracene porewater concentrations in the first centimetre of capping material, were reduced by 69%, 56% and 99% respectively for activated carbon, organoacyl 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 were measured as indicators that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**WE426**

**Remediation of mine wastes with biochar: effect on metal bioavailability to earthworms**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diaz-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 tissue metal concentration remained constant. No significant differences observed among treatments and incubation conditions. A strong decrease in Cd, Zn and Pb CaCl2-extractable fractions was observed in all mine waste dilution in both biochar treatments comparing to untreated mine waste, with no significant differences among treatments or flooding conditions. Addition of biochars also leads to an increase in the pH, which might explain the reduction in metal bioavailability fraction and the consequent decrease in organisms’ body metal bioaccumulation.

**WE427**

**Remediation of mine wastes with biochar: effect on metal bioavailability to Earthworms**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diaz-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 characterizations, 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 bioavailability and risk of exposure. Survival of E. crypticus exposed to mine waste water solutions in an inert quartz sand matrix was assessed for 21 days. PCB tissue concentrations in different sorbent materials (AC, OC and BC) were measured as indicators of remedy effectiveness. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured to determine that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.
**WE429**
Identification, Quantification, and Risk Assessment of Polycyclic Aromatic Hydrocarbons and their Polar Derivatives in Soil After Steam Enhanced Extraction

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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 additional heat of steam to significantly increase the removal efficiency and recovery of volatile and semi-volatile contaminants, like PAHs. However, there is limited research on the 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). Lr 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 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 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-leafmate 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

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Fuels and lubricants are complex mixtures of hydrocarbons. Low 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 the potential for biodegradation of diesel using microbial biocatalysis in the presence of surfactants. Combustion products of diesel are complex mixtures of hydrocarbons, and these compounds can be biodegraded at varying rates. In this study, the biodegradation potential of diesel fuel was investigated using serial surfactant foam spraying technology, which avoids disturbing the soil, to deliver oxidants and oil degrading microbes to unsaturated soil. Hydrogen peroxide was used as the oxidant and oil degrading microbes 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 total petroleum hydrocarbon (TPH). Periodic bioaugmentation foam was sprayed every three days for biodegradation of 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 deprotonation

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Clays have been used by mankind to many years due to its easy to obtain, its high carbon sequestration and its assumed stability, BC is considered an environmentally compatible approach for carbon sequestration and thus, climate change mitigation. Its application to agricultural soils has been shown to increase soil fertility, mainly due to improved soil structure, water and nutrient retention, and microbial activity. However, availability of contaminant and its bioavailability plays a critical role in determining the efficiency of these contaminants. Given that the application of this work was made from 2,6-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 deprotonation of the halogenated phenols controls whether other factors were 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

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Biochar (BC) is a product of thermal decomposition of biomass under oxygen-limited conditions. BC has received extensive attention because of its multifunctionalities for agriculture including improving soil structure, water and nutrient retention, and microbial activity. Its excellent functionality for agricultural and environmental applications. Its excellent performance in 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 uptake of chlorinated pesticide into grapevine, Danio rerio (zebrafish) 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. Aguiar 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 prominence in the scientific community. 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-bromoindenedioen polymer, the process of cation exchange, which generated organophilic characteristics for samples, allowing clays to be used as sorbents of organic compounds were used. Serious damage to fauna and flora are caused by the use of organic compounds as biodegradable hydrocarbons. This leads to search for new methods aimed at removing it mainly aquatic environment. Given that the application of this work aimed at the preparation and characterization of organophilic clays, as well as to evaluate its adsorption rate of these compounds organics. Para it was used a natural clay from the Carolina-MA region. infrared techniques, X-ray diffraction, scanning electron microscopy (SEM), mass determination tests adsorbent and determining the content of contaminants on the samples were used. At the end of the process it was noticed a structural modification of the clay shown in SEM, but also the vibrational result given by the infrared showing major carbon chains present in the composite nano derived polymer, it caused a significant increase of
Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms

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Nowadays, the ecological impact of microplastics in freshwaters is not well understood [1]. Here, we have investigated the effects of microplastic particles (nominal size 5 mm) of polyhydroxybutyrate (PHB) in two organisms representative of freshwaters, the filamentous cyanobacterium Anabaena sp. PCC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and the potential degradation processes of 1.5 µm PP particles by nanoparticle tracking analysis (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). Then, we have evaluated the biological effects of PHB on cellular growth, pigment content and several physiological parameters (metabolic activity, formation of intracellular reactive oxygen species and cytoplasmic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoparticles. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MilIQ finding a wide range (75 - 300 nm) of PHB nanoparticles. PHB induced a decrease in cellular growth and chlorophyll content in both photosynthetic organisms. Furthermore, PHB induced an increase in the level of intracellular reactive oxygen species and induced changes in membrane potential. In conclusion, microplastic particles of PHB exhibited toxicity towards photosynthetic organisms and their effects on release of a wide range of nanoparticles as a consequence of its own abiotic depolymerisation. [1] Koelmans AA, Besseling E, Shim WJ. 2015. Nanoplastics in the aquatic environment. Critical review. In Marine anthropogenic litter (pp. 325-340). Springer International Publishing. Acknowledgement - This research was supported by CTM2016-74927-C2-2-R grant from MINECO/FEDER EU.

Ecotoxicology of micro and nanoplastics: Mechanistic approaches to understand their risk for the environment and human health (P)

TH001

Synthetic textile fibers end up in agricultural soils - Can these microplastics pose a threat on soil organisms?

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An important route of microplastics (MPs) to the environment is the release of synthetic textile fibers to waste water due to laundry. The major part of the fibers is retained in the sewage sludge during waste water treatment and ends up in green spaces and agricultural fields. In this study, we explored the accumulation and effects of polyester fibers in soil in a field experiment. The concentrations measured in the bauxite residues do not predict the bioavailable (potentially toxic) fraction of the TE, therefore bioassays should be taken into account when fixing the rehabilitation goals or assessing the rehabilitation success of a contaminated area.

TH002

Differential responses of biomarkers in tissues of the blue mussel Mytilus edulis exposed to microplastics at environmentally relevant concentrations

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Since the early 1970s, the occurrence of floating plastic has been reported in marine waters with great accumulation in gyres. In recent years, the presence of plastic debris < 5mm called microplastics (MPs) which result mainly from macroplastic’s fragmentation has also been reported in aquatic ecosystems even in remote areas. Several studies have reported the presence of MPs and their effects in release of organisms. However, it appears necessary to investigate their potential toxicity especially at environmentally relevant concentrations. The aim of our study was to evaluate the bioaccumulation and toxicity of polypropylene (PP) and polyethylene (PE) fragments towards the blue mussel Mytilus edulis. These polymers were selected according to a previous study conducted in situ in the Region Pays de la Loire (France) in 2014, where 10 days of exposure to environmentally relevant concentrations of 0.008 and 10 µg/L (9 and 11.250 particles/L respectively) (Desforges et al., 2014), and to a higher concentration of 100 µg/L (112 500 particles/L) of each MPs type. The exposure was followed by 10 days of depuration in clean seawater (without MPs). MPs fragments were prepared in the laboratory from commercially available products by milling; characterized in terms of size, shapes and they were counted. Following exposure, tissues and biodeposits (faeces and pseudofaeces) were chemically digested and analyzed for MPs recovery using infrared micro-spectroscopy. Regarding potential toxic effects, detoxification and oxidative stress mechanisms through measurement of enzymatic activities of Glutathione-S-transferase (GST), Catalase (CAT) and superoxide dismutase (SOD) were evaluated as well as biomarkers of immune system and DNA damage. Results showed the presence of PE and PP particles in digestive glands of mussels exposed to the highest concentration tested (100 µg/L) of MPs, and in biodeposits where MPs were observed at all tested concentrations. Significant increases in SOD and CAT activities were observed in the digestive glands of mussel’s exposed to 0.008 and 10 µg/L and in gills from mussels exposed to 100 µg/L of MPs that could be indicative of an oxidative stress. This study brings new results on the potential sublethalt effects of MPs at environmentally relevant concentrations of MPs.
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 composition 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 microparticles (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microparticles 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 for candidate genes involved in the response to microplastics via illumina sequencing. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microparticles 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 Palaemon 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 harmful effects. This study investigates the effect of size of artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaemon 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 fluorescent 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 supra-gastric tissue of the midgut gland. Decapsulated shrimp was fed a stomach with fine-meshed filter structures which prevent the uptake of particles > 170 nm into the digestive gland. Superoxide dismutase activity was rapidly induced when the animals were exposed to 0.1 µm plastic particles. The activity increased within 2 hours after microplastic 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**

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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 [likely at the depth of the pycnocline (200-600m)]. This study investigated the presence of microplastics (TH008, TH009, TH010) in the sub-surface layers 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 six timepoints of 20 m (0-20 m, 20-40 m, 40-60 m, 60-80 m, 80-100 m, 100-120 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 dissecting 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 20-40 m, 14% in 40-60m, 9% in 60-80m, and 8% in 80-100m. There was a high microplastic count near the South African coast (10^4-60-10^3). 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**

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The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route of plastic debris for various aquatic animals, 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 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 transporting 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- virgin) or particles exposed to sewage (PS-sewage) and industrial harbor (PS industrie). The study includes feeding experiments (TH004, TH005, TH006) to assess the functional adversity of dietary PS MPs exposure, integrity and transport function of the proximal and distal intestine was investigated. Metabolically active intestinal epithelia was mounted in modified Ussing chambers. Epithelial integrity was monitored as the transepithelial electrical resistance (TER,Ω·cm²) and the diffusion rate of 14Cmannitol. Active transport was evaluated as potential difference of artificial (TER, V) and natural (TEP, mV) transepithelial electrical resistance (TER, V) and natural (TEP, mV) transepithelial electrical resistance and short circuit currents (STC, µA/cm²) together with uptake rate of 'H-lsine. Overall morphology was observed using histology. Gene expression analysis of immune related genes (TGF-β, TNFα, IL-8, IL-10, IL-17, IL-14/13A) and tight junction proteins (Occludin, ZO-1, Tricellulin) was performed to examine if PS particles and chemical contaminants induced inflammation in intestinal tissue. The innate immune response (lysozyme stability and complement system) in blood plasma was evaluated to assess the presence of systemic inflammation. The findings of the study indicated no or minor functional effects on fish intestinal tissue inflicted by particle exposure. Signs of inflammation were detected and were accompanied by upregulation of tight junction proteins, suggesting activation of intestinal homeostasis in response to PS MPs exposure.

**TH008 Biochemical responses and histological effects resulting from foodborne exposure to post-consumer microplastics in juvenile Solea senegalensis.**

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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 MP s 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 ad 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 the marine fish 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 MP s 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 intestine from each 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
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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 in size of small plastic particles like microplastics (<5 mm) and nanoplastics (≤100 nm) are getting a lot of attentions 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 mussels (Mytilus edulis) contaminated with nanoplastics (44 nm diameter) and their physical (length, weight, water contents, 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 mussels entered the bodies of shrimps and affected the health and physiocochemical properties of shrimps. Especially, biochemical changes of shrimps are 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 (2016R1A2B3S014445).

TH100

Brood Pouch-mediated Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis
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Nanoplastic debris is ubiquitously distributed in aquatic environments and are considered an emerging environmental issue for aquatic organisms across trophic levels. While ingestion of particles receives most attention, other routes of uptake and cellular uptake remain unexplored. Here, the planktonic filter feeder Daphnia magna was used to track routes of uptake and target tissue of polystyrene nanoparticles (PSNP). A sub-lethal concentration of 5 mg L\(^{-1}\) fluorescent PSNPs (25 nm) was used to monitor accumulation in adult animals as well as their embryos in the open brood pouch. A time series throughout embryonic development within the brood pouch revealed accumulation of PSNP in lipophilic cells in the early stages of embryonic development while the embryo is still surrounded by a chorion and before beginning of organogenesis. In contrast, PSNP particles were neither detected in the gut epithelium nor in lipid droplets in adults. An \(ex\) vivoexposure of embryos to PSNPs was similar to adults. Furthermore, the generation of PSNP-exposed mice, 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 in 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.

TH101

Micro- and nanoplastic ingestion in blue mussel larvae
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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. Here we investigate how larvae of Mytilus edulis are exposed to nano-sized plastics, and the effects of an acute exposure. We present an experimental investigation of ingested microplastics in the larval stage of Mytilus edulis. The first experiment aimed at quantifying the amount of ingested and egested particles. Ten day old larvae were exposed to two different sizes of fluorescent polystyrene microbeads (2µm and 100nm) and body burdens of particles were quantified after 4h. Subsequently, larvae were transferred to clean water to measure the amount of egested particles after 45h and 72h. The second experiment investigated potential effects of plastic particles on growth and development of the larvae. They were exposed to 3 different concentrations of the 2µm and 100nm beads, representing low (0.45 µg/L), medium (28.7 µg/L) and high (287 µg/L) exposure levels, for 2 weeks. Every 2-3 days larvae from the different treatments were sampled, fixed and photographed to analyse larval size and morphology. Results showed that the larvae readily ingested both particle sizes although ingestion appeared to be more efficient for the 2µm beads. Egestion of micro- and nanoplastic particles did take place but was not complete within 72h, with 43% of the 2µm and 61% of the 100nm particles remaining in the animals.

Potential effects on larval growth and development remain to be analysed. By taking other life stages into account and using a quantitative approach for analysing particle ingestion and egestion, this study contributes to enhancing the mechanistic understanding of microplastic – blue mussel interaction.

TH102

The sub-lethal impact of polystyrene microplastics and nanoplastics on the Mediterranean mussel M. galloprovincialis
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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 mussel Mytilus galloprovincialis. To do so, we employed a multibiomarker approach encompassing immunological responses (lysozyme and phagocytosis), lysosomal 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 treatments in general and also by the immunocyte 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 15 ng/L MP. In Gill, catalase was up-regulated following either MP (1.5 and 15 ng/L MP) 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 scaled 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 (0.05 ng/L) was at 1.5 and 15 ng/L NP 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 differently alter immunological and neurological processes, with the exposure to NP resulting in a higher impact on the overall mussel fitness compared to MP.

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Effect of cationic amino (PS-NH2) polystyrene nanoparticles in brine shrimp Artemia franciscana nauplii: biochemical and molecular responses
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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 of A. franciscana. The 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 (CbE), 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.
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 threat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering long-term exposure to analyze the potential risk of nano-sized plastics in marine environments.

TH014 The impact of nanoparticles on Antarctic krill Euphausia superba
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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 αααα66 gene involved in new formation of the chitin frame. No changes on microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in facetal pellets (FPs), which were characterised by lower density and sinking rate compared to our controls. 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
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Physical and chemical changes in the 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 carboxazepine (cbz) toxicity on bivalve Mytilus galloprovincialis. Mussels were exposed for 96h to 3 concentrations of PSNP (0.01, 0.1, 1 µg/ml) in seawater. 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 oxidant 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 mg/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 AST and ALT values. Genotoxicity was found in hemocytes after exposure to PSNP, cbz and their mixture.

TH016 The role of microplastic size and type on PAH sorption and bioavailability to copepods
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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, MP 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 MPs, 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 are unable to accurately determine if PAHs are released from adsorbed compounds or free 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-dimethylphenanthrene) to a range of different MP’s in natural seawater. The selected PAHs exhibit different sizes and hydrophobicities, thus having varying surface solubility (two orders of magnitude). In the case of the least soluble compound, fluoranthene, MP sorption could prove an important route of uptake in pelagic organisms. To account for the natural variability of MPs present in the marine environment, test materials with different sizes, shape (particles, fibres) and polymer compositions (polyethylene and polystyrene microbeads, polyster 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)
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The impact of nanoplastics on Antarctic krill Euphausia superba
G. Liberatoroti, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Manno, C.M. Waluda, British Antarctic Survey; S. Cappello, CNR IAML; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

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, MP is high. In both field and laboratory studies, a broad range of
Arctic), a range of different virgin polymer pellets (LDPE, PP, PS and PE), 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 SMMD 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 12 months after deployment. Hydrophobic persistent organic pollutants such as PCBs, CDTs, DPBs and PBDEs and their metabolites were measured to establish the adsorption kinetics in seawater under Arctic conditions. Samples were extracted using ultrasound and nonpolar solvents, followed byGPC and SPE clean up. Analytical procedures using GC/MS/MS and GC/MS/MS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common pharmaceuticals (antibiotics, phthalates, organophosphate esters, bisphenol A and perfluorinated chemicals) were estimated from ortho carbon as well as 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. Alibendin, Universidad de Cádiz / Toxicology Area; I. Cabrera-Pozo, University of Cadiz / Toxicology Area; D. Coello, R. Rodríguez-Barroso, J. Quiroga, University of Cadiz / Environmental Technology; J. Arellano, University of Cadiz / 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 microbeads 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 microbeads available in these samples were separated and chlorified. 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 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 12h light/12h dark exposure. The juveniles of Solea senegalensis (weight 3.07 ±0.49 g) were exposed to two nominal concentrations of chlorpyrifos (5-80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-20 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. Cholinesterases (ChE) have been used as specific biomarkers of aquatic organisms to environmental pollutants. 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 crustace 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 chemicals? C. K. Frydjer, 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 the study aims to investigate the inhibitory effects resulting from dietary exposures to PS particles ranging in size 50-250 µm. In this study, the rainbow trout (Oncorhynchus mykiss) were exposed diets, enriched with PS particles (10mg of PS particles/Fish/day) for 28 days. We used environmentally contaminated PS particles from in situ exposures from two environmental matrices (undiluted seaweed effluent and industrial harbor runoff). As PS particles largely exceeded sizes relevant for biofilm uptake, it provides an opportunity to study particles’ role as vector for environmental pollutants. Three different experimental diets, containing PS, PE (seaweed PS) and PA (paper PS) were used. Selected particles were spiked with a mixture of hydrophobic chemicals (PAHs, PCBs, DDTs, PBDEs and pesticides) and used to enrich the experimental diets (3 mg of PS particles/ diet) at concentrations ranging from 40 to 400 µg/l. The juveniles of Daphnia magnae (weight 3,07 ±0,49 g) were exposed to five experimental diets, containing virgin PS particles and virgin PE particles. The diets were measured daily (6 % of body weight and 5 % particles) for a period of two weeks. Gene expression of cytochrome P450s (CYP1a, ERα and β), aryl hydrocarbon receptors (AhR, AR, MT, VTG) were quantified to provide additional insights into hepatic responses to dietary PS MPs exposures. The findings of this study revealed an indication of NQR2-mediated oxidative stress regulation.

TH021 Microplastics as vectors for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds M. Trefi,ph, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; Carney 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). Hexa-chlorophenol 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, ethynlestradiol 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 wellestablished biomarkers (CYP1a, ERα and VTG) were then quantified at mRNA level in the liver and gut. Acetylcholinesterase (AChE) activity was measured in brain. Results showed that all treatments containing mixture chemicals caused changes in gene expression and altered enzymatic AChE activity. Differences could also be seen between particle types, where PS contaminated particles showed similar pattern with the non-plastic particles, while PE contaminated particles showed significant changes, indicating a role for transfer of chemicals. The chemical control was for some treatments lower than the particle groups indicating a particle-mediated chemical transfer in fish.
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
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Infrastructure and Society
Nanoplastics (NPs, ≤ 1, µm) 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
information 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
Tributyltin (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 (12ºC) 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 mg/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 microprofiler 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/or TBT concentrations in 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 and Enables Sorbed Benzo(a)Pyrene Bioavailability
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Society
Microplastics (MPs, 5 mm–1 µm) and nanoplastics (NPs, ≤ 1 µm) can result from
larger plastic debris released in the environment and can pose a risk to aquatic
organisms. Potential effects of MPs include disruption of gut physiology after
ingestion, release of substances (co-contaminants) sorbed to MPs into organisms,
and occlusion of tissue surfaces by accumulation of MPs. Although not yet
effectively measured in aquatic environments, NPs may be the most abundant
plastic particles present, but little is known about their effects in organisms.
Because the relative surface area is greater for NP than MPs, there is greater
potential for co-contaminant sorption to NPs and subsequent co-contaminant
release into organisms upon ingestion. We evaluated the bioavailability of the
co-contaminant Benzo(a)Pyrene [B(a)P] sorbed to nanopolystyrene (nPS, 500nm)
by assessing the expression of cytochrome P450 1A (cyp1A) in zebrafish (Dania
reno) larvae (96h postfertilization, hpf). The effects of nPS and nPS with sorbed
B(a)P on larval (96 hpf) metabolic rate were assessed over a 24h exposure. The
concentrations tested for nPS and nPS with sorbed B(a)P were 0-50 μg/ml of
particles, and 0-40 μg/L for B(a)P. Proof of particle ingestion by larvae was
observed using fluorescent nPS (500 nm, μg/ml). Whole-organism metabolic rate
(MR) was assessed by measuring oxygen uptake (MO2), using respirometry
chambers (24 ml) and Pre-Sens optodes. The expression of hypoxia related
molecular biomarkers [cytochrome c oxidase subunit IV isoform 1 (cox4i1),
hypoxia inducible factor 1, alpha b (HIF-αb)] was assessed in the same larvae. Gene
expression was measured by quantitative reverse transcription PCR (RT-qPCR)
after RNA extraction from whole larvae. Sorption of B(a)P to nPS was confirmed
using analytical chemistry techniques [gas chromatography–mass spectrometry
(GC-MS)]. Preliminary dose-response analysis showed that nPS, B(a)P and nPS
with sorbed B(a)P induced a decrease on MO2 by zebrafish larvae, indicating a
higher energetic cost of physiological functions maintenance. The expression of

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cyp1A was up to 9 fold change in the highest concentration of nPS (45 μg/ml) with
sorbed B(a)P, whereas this gene did not expression when larvae were exposed just
to nPS, indicating desorption of B(a)P. We anticipate that our results (ongoing data
analysis) will contribute to a better understanding of the effects and risk of NPs and
their co-contaminants within a more environmental relevant scenario.
TH025
Impacts of exposure to microplastics alone and with adsorbed benzo(a)pyrene
on biomarkers and scope for growth in marine mussels M. galloprovincialis*
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Biology and Biotechnology PIE; E. Navarro, University of the Basque country
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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 exposure to polystyrene MPs of 0.5 and 4.5 µm alone and with 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 whole organism responses (scope for growth [SFG] 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 CAT but not in DNA damage despite the genotoxicity of
BaP. An apparent increased effect of smaller MPs on DNA damage was also found.
A general hormetic 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
effects at different levels of biological organisation. Further work is required to
understand the effects of a variety of plastic type, size, shape combinations together
with a wide variety of pollutants.*Funded by Spanish MINECO (NACE project
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PLASTOX (JPI Oceans 005/2015).
TH026
Characterization of the adsorption/desorption of benzo(a)pyrene to/from
polystyrene micro- and nanoplastics for further toxicity assessment
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and Biotechnology PIE; H. Budzinski, University of Bordeaux
Degradation processes that large plastic items undergo in the sea have led to the
appearance of small plastic pieces known as micro- (MPs) or nanoplastics (NPs),
depending on their size. MPs and NPs can also be specifically manufactured for
industrial and domestic applications, which results in an additional source of
pollution. MPs and NPs become available to biota and enter into the food web.
Moreover, due to their physico-chemical properties, such as large surface to volume
ratio and hydrophobicity, plastics can adsorb/absorb other pollutants present in the
water column acting as Trojan Horses. In order to further investigate the
ecotoxicological aspects of this phenomenon, the characterization of the adsorption
of benzo(a)pyrene (BaP), as a model polyaromatic hydrocarbon, to polystyrene
MPs and NPs (4.5, 0.5 and 0.05 µm), was undertaken. 50 mg.l-1 of plastics of the
three sizes were incubated for 24 h in an orbital shaker at 300 rpm (21°C) in three
BaP solutions (100, 10 and 1 µg.l-1 containing 0.01% DMSO) in MiliQ water. After
the adsorption period, centrifugation was performed in order to settle the plastic and
allow the removal of non adsorbed BaP (NA-B(a)P). NA-BaP was quantified in the

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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 indicate that the adsorption capacity of a high density polyethylene (HDPE) of 0.45-µm size was 90.88% and 37.18% with a Qmax 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 B(a)P to MPs and is currently being applied to NPs. * Funded by French ANR (NATEX-03-12) and Cluster Excellence COTE (ANR-10-LABX 45), Spanish MINECO (NACE project — CTM2016-81130-R), Basque Government (consolidated research group IT9010-13) and UPV/EHU (UI 11/37 and grant to IMA).

TH027 Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord A. bourn. ECOLAB UMR254 CNRS UPS INPT; C.G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Politecnico University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Environmental Sciences; N.B. Hartmann, Technical University of Denmark and Environmental Sciences; N.B. Hartmann, Technical University of Denmark / DTU Environment and Environmental Sciences; N.B. Hartmann, Technical University of Denmark / DTU Environment and Environmental Sciences; N.B. Hartmann, Technical University of Denmark / DTU Environment; T. Neuveglise, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Plastic Partner GmbH; L. Schebek, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; K. Sakaguchi-Soeder, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; L. Schebek, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; M. Gottschling, Y. Zhou, I. Schwabe, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Plastic Partner GmbH; L. Schebek, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; C. Gorbi, Politecnico University of Marche / Department of Civil and Environmental Engineering; A. Goharia, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy; M. Gottschling, Technische Universität Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Plastic Partner GmbH

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 investigate the presence of microplastics in ten sedimento-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-FT-IR analysis revealed the presence of various plastic polymers: polyethylene, polypropylene and polyamide 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, polyester, 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 K. Sakaguchi-Soeder, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; T. Neuveglise, Technische Universitaet Darmstadt / Department of Civil and Environmental Engineering; A. Goharia, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy; M. Gottschling, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Plastic Partner GmbH

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 understanding of plastic usage and consequential exposure to plastic materials in our everyday life. In recent years, the focus and extent of this debate have increased 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 potential risk posed by microplastics in certain products but no actual effects on humans. It is without question that plastics can constitute a human health risk due to the toxicity of associated chemicals and to particle toxicity. 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. However, this 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. However, this degree to which microplastic exposure via food products and beverages contributes to this health risk is likely insignificant at present time. 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TH031

Is the Arctic threatened by plastics? Identifying sources and determining the distribution of microplastics around Svalbard

L. Winberg von Friesen, University of Gothenburg, Sweden / Marine Sciences; M. Hassellöv, University of Gothenburg / Department of Marine Sciences; G.W. Gabrielsen, H. Hop, Norwegian Polar Institute; T. Brown, Scottish Association for Marine Science; M.E. Granberg, IVL-Swedish Environmental Research Institute / Research group on plastics

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 possible entry points such as in deep ocean sediments and buried within 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 different sites associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic marker tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and sewage (coprostanol) 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 species already burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

TH032

Microplastics - an ecotoxicological issue? How to balance facts and perception without marginalizing an environmental problem

C. Völkel, 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 only slowly made its way to the public awareness. In the 2000s, small plastic particles that had already been detected in seawater in the 1970s were labeled “microplastics” for the first time. Since then, the number of studies on the occurrence and effects of microplastics has risen exponentially. 13 years after the publication of the article by Thompson et al. the question of whether microplastics actually pose a risk to the environment could not yet be answered conclusively. In this study, 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 different sites associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic marker tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and sewage (coprostanol) 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 species already burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

TH033

Assessing biotransformation and bioconcentration factors (BCF) of fragrance materials using in vitro approaches utilizing rainbow trout liver S9 sub-cellular fractions and cryopreserved hepatocytes

A. Łapczynski, RIFM / Environmental Science; K.M. Johanning, JK Scientific LLC / dba of Pura Vida Connections LLC; A. Jenkins, EAG Laboratories

Bioaccumulation potential measured as the bioconcentration factor (BCF) is one of the components for the PBT (persistent, bioaccumulative, toxic) criteria and risk assessment of chemicals by regulatory agencies in some regions of the world (e.g. REACH and ECHA). BCF are used to estimate chemical exposure and help to identify the source of uncertainty in bioaccumulation assessment. Currently, in vitro methodologies utilizing the rainbow trout metabolic assay not only are gaining interest, but are being used increasingly by several sectors as a crucial component in model-based estimates of BCFs and as part of a line of weight of evidence presented to regulators. The rainbow trout liver S9 assay utilizing liver S9 fractions and cryopreserved hepatocytes to test chemical biotransformation has gone through a Ring Trial for an OECD validation process (OECD Project 3.13 coordinated by ILSI HESI) and the Test Guidelines and Guidance are being reviewed by the OECD assigned panel. In the present study four fragrance materials (Cyclamate, Melafeur, Trimoxif and Verdox) with known measured BCF values obtained using OECD 305 method were tested for biotransformation utilizing both rainbow trout liver S9 fractions and cryopreserved hepatocytes. The results indicate that all four fragrance materials were metabolized in both biological systems at different rates, but in all cases the BCFs determined were comparable to the measured in vivo BCF values. The in vitro metabolic assay is a powerful tool that can be used to determine BCF of test chemicals and provide data to build the database information on fragrance materials for fish metabolism and modeling.
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 limited affinity to lipid content in tissues, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of DAPs and DAPs than the other tissues of fish. It suggested the expression of P450-mediated DAP biotransformation in wild animal studies. In the subsequent laboratory control study, we screened the metabolites of alkyl-PFRs by in vivo exposure of *Gobiocypris rarus*. Metabolites of alkyl-PFRs in fish liver after 30-day exposure were analyzed with UPLC-TOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxylation, dihydroxylation, desaturation, and phase II glucuronidation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BBOEHEP, and 3-OH-TNBPEP 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 vitro 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 widely used to control pests and diseases. However, the health risk from the exposure of aquatic organisms has been recognized as a model organism to test toxicity of organic chemicals due to its rapid life cycle, the feasibility of culturing 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 thereby, influencing their bioaccumulation. The aim of this study was to assess the toxicokinetics 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 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 each profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 Kg⁻¹. Finally, the data will be modeled using non-linear regression methods. A good understanding of the accumulation and transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in *Hyalella azteca*.

**TH037 Toxicokinetics and metabolite identification of two emerging pollutants, Atrazine + K and 4-MBC, in the Manila clam *Ruditapes philippinarum***

D. Fedrizzi, Eawag - Swiss Federal Institute of Aquatic Science and Technology - Environmental Chemistry; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag - Environmental Chemistry

Atrazine + K and 4-MBC, in the Manila clam *Ruditapes philippinarum*, was assessed in a laboratory control study, we screened the metabolites of alkyl-PFRs by in vivo exposure of *Gobiocypris rarus*. Metabolites of alkyl-PFRs in fish liver after 30-day exposure were analyzed with UPLC-TOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxylation, dihydroxylation, desaturation, and phase II glucuronidation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BBOEHEP, and 3-OH-TNBPEP 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 vitro rat exposure studies. Overall, the results emphasized the importance of hydroxylated metabolites as biomarkers for alkyl-PFRs exposure.

**TH038 Organophosphate Esters, Including Alkyl-Substituted Triphenyl Phosphates, in East Greenland Polar Bears and Ringed Seals: Adipose Tissue Concentrations and In Vitro Depletion 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 / Ecology Institute and Wildlife Health Canada

East Greenland is a contamination “hot spot” for long-range transported anthropogenic chemicals, including organophosphate esters (OPEs). High concentrations of OPEs 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 OPE 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 (OPE) triesters and corresponding OP diester formation were investigated in East Greenland (Scoresbysound 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 OPEs 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 by PBs. Metabolites of 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 - 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 Analysis; H. Mellett, 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 lives 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 liver followed by separation of the subcellular fractions. Cells are isolated from the liver, homogenized, and the subsequent separation of the subcellular fractions. The cells of one of these animal-derived products is called rat liver homogenate (S9) and includes the cytosolic and the microsomal fractions. It consists of enzymes for phase I and phase II biotransformation reactions. This product is very prominent in various OECD and ISO test guidelines for bioassays that are not by themselves capable of a metabolic transformation. The most prominent example is the Ames test in which S9 is added to the reverse mutation assay according to the NIH 11350 or the OECD 471. However, the application for S9 is much more diverse and spans from various not guideline-based bioassays towards the ad-hoc production of metabolites for chemical analysis. It is also applied for stability testing of pharmaceuticals and the observation of the potential in bioaccumulation of chemicals and their metabolites. In this study, we look at the proteomics of multiple rat S9 products and compare them with an animal component free biotechnological alternative.

**TH040 A critically evaluated database of in vitro and in vivo toxicokinetic data for...***

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mammals and fish
J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; A. Looky, ARC Arnot Research and Consulting Inc.; K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMOD); J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHC EUR V ECVAM; A. Lostia, European Commission Joint Research Centre; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EUR V ECVAM

Toxicokinetics (TK) plays an important role in ecological and human health assessments. In vitro methods applied, yielding parent compound loss rates as well. In vitro methods are used to determine the combined biotransformation/permeation rate through this epithelial model. Primary suspension preparations from hepatocytes and intestine are explored for biotransformation rates (i.e. loss of parent compound), permselective cell lines of gills, liver and intestine, exposed in monolayer, complement to the in vitro methods applied, yielding parent compound loss rates as well. In vitro methods are each applied under their respective optimal conditions, taking e.g., temperature and media composition into account. Chemical starting concentrations are set uniformly for all models based on non-toxic concentrations and analytical method sensitivity. Thus far, permeation/biotransformation was observed for all chemicals applied. The resulting rate constants are subject to comparison between the different in vitro models and are input into the TK and QSAR models for model development and hypothesis testing. This poster will describe the overall in vitro testing strategy, the different in vitro models and the results of the chemical testing with regard to to in vitro-derived rate constants.

TH042 Update on development of OECD Test Guidelines and Guidance Document on determination of fish in vitro hepatic clearance

Chemical biotransformation represents the largest source of uncertainty in chemical bioaccumulation assessments, and model-based estimates of chemical bioconcentration in fish may be greatly improved by including biotransformation rates, as measured in vitro. Substrate depletion assays, using rainbow trout hepatocytes (RT-HEP) or liver subcellular fractions (RT-S9), have been successfully developed and validated for the prediction of fish biotransformation. We have conducted a multi-laboratory ring trial, coordinated by the ILSH Health and Environmental Sciences Institute (HESI), was recently completed which demonstrates assay reliability within and across laboratories and similar performance of substrate depletion assays using the two biological systems. Based on the successful results of this ring trial, two OECD test guidelines (TG) (“Determination of in vitro intrinsic clearance using cryopreserved rainbow trout hepatocytes” and “Determination of in vitro intrinsic clearance using rainbow trout liver S9 sub-cellular fractions”) have been drafted and are accompanied by a Guidance Document (GD). The OECD GD provides detailed information on how to conduct the tests as well as how to apply the measured in vitro biotransformation rates to predict bioconcentration factors. In addition, guidance on selection of the assay system (e.g., primary hepatocytes vs. liver S9 fractions), specific considerations for testing chemicals, use of negative and positive controls, BCF extrapolation models, and application of the two test methods beyond BCF prediction are also covered. Draft TGs, the GD, and the ring trial report underwent two OECD public comment rounds during 2017 and submission to OECD WNT final approval is planned for 2018.

TH043 The Bioaccumulation Assessment Tool (BAT): A quantitative weight of evidence approach for bioaccumulation assessment
L. Teens, ARC Arnot Research & Consulting; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; 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. Stadnicks-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 exposure and test results, bioconcentration and bioaccumulation factors (FBC and FA), and in vivo extrapolation methods. In a first step, we derived a set 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 categories based on predominant exposure route(s) to guide in vitro testing: 1) log K<sub>ow</sub> < 4 (aqueous exposure dominates – to be tested in gill and liver models); 2) log K<sub>ow</sub> = 4.5 - 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>ow</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 are used to determine the combined biotransformation/permeation rate through this epithelial model. Primary suspension preparations from hepatocytes and intestine are explored for biotransformation rates (i.e. loss of parent compound). Permanent cell lines of gills, liver and intestine, exposed in monolayer, complement to the in vitro methods applied, yielding parent compound loss rates as well. In vitro models are each applied under their respective optimal conditions, taking e.g.,
well 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 scenario in which both DETE (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 considerations**

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 (k_e) experimentally while the uptake rate (k_u) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to k_u 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 vitro biotransformation rates (k_u) 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 k_e based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro k_u of different tissues, e.g. gills, liver and gastrointestinal tract, could be serve as alternative screening criterion under REACH. This poster will briefly 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 k_e 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-Continental Ecology Division

**Advances in evaluating and regulating endocrine disruptors**

**(P)**

**TH046**

**Progress of the Japanese Program on Endocrine Disrupting Effects of Chemicals: EXTEND2010**

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 (MOEGR) 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 the 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 exposure to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, perfluorinated 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 documents, 242 in vivo fish tests, 377 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 biodicators for each of the EDs.

**TH048**

**Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities**

A. Kienzl/IBER, JRC-EC / F3-Chemical Safety and Alternative Methods

Unit-EURL ECVAM; Z. DANG, RIVM / LIEC CNRS UMR; S. van der LINDEN, JRC-EC

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 agencies and/or sector-endorsed test sets. Considering the chemical spaces for which various LOE exist (e.g., 3 lab BCFs, various BCF-QSARs) the inclusion criteria for the review. The data was and the QWOE. This has resulted in attempts to develop and validate a battery of

**TH049**

**Towards developing a list of reference chemicals for endocrine assay validation**

C. Prosseg, 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 aimed 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 inter-laboratory 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 was chosen for the validation procedure. Additionally, reference chemical selection is often not considered, meaning that the data generated when validating these assays 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 was summarised and processed 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 chemicals, is obtained by getting the collected chemical 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
S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. Lostia, European Commission Joint Research Centre / A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit -UNIT-EURL ECVAM; E. Grignard, European Commission Joint Research Centre; S. Munn, European Commission 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 guidelines, scientific literature and other available data to assess and categorise all pesticides and biocides currently registered in the EU. This assessment will be part of the 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 dossier 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. Milam, ICRP, ER2, Dose Chemical Company / Toxicology. Environmental Research & Consulting
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 endocrine mediated (i.e. those that involve bioactivity and mechanistic potency) and non-endocrine effects. 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.
Structure Alerts forPotential Endocrine Disruptors

R. Kühne, N. Ost, Helmholtz Centre for Environmental Research UFZ / Department of Ecological Chemistry; L. A. Baumann, University of Heidelberg / Agricultural Ecology and Toxicology; H. Segner, 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 aryl-hydrocarbon receptor interaction. Structural alerts to predict chemicals with potential effect on these systems have been developed. For estrogen/ androgen systems a set of structural alerts 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 95% of the known active compounds, but there is suspect 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/cochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 3714 63 412 (0).

Mixtures of endemic disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae

L. Birgersson, J. Stürve, 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, neuroendocrine and brain development. 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 (phthalate metabolites, phenols and PFASs) were synthesized and tested in a range of in vivo and in vitro systems. The thyroxine 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 identify disruption of TH-related gene expression in zebrafish (Danio rerio) during early development. Zebrafish embryos were exposed to Mix X 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 behavior caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be an early indicator of 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 thyra 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.

Contaminants of emerging concern in the North American Great Lakes: Assessing environmental mixtures in multigenerational exposure studies

N. Cipoletti, St. Cloud State University / Aquatic Toxicology 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 pathological 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 indicate lower effects on reproduction at levels for first generation only, whereas the second generation demonstrated decreases in environmentally relevant concentrations as compared to low and control treatments, fish, highlighting the differences between adult only exposed fish (first generation) and lifetime exposure (second generation). Urban exposure demonstrated no changes to male plasma VTG (egg-yolk precursor protein), but agricultural exposure demonstrated increases in high exposed male fish (first and second generation) and environmentally relevant exposed male fish (second generation) due to the estrogenic nature of the mixture and exposure during different developmental stages between generations. Results indicate that mixtures, environmentally relevant in composition and concentrations, have the potential to alter gene expression, leading to reductions in fecundity, and elevated egg-yolk precursor protein in male fish. Potential, yet unknown, consequences to the population level of exposed aquatic organisms may exist and warrant further study.

Contaminants of emerging concern in the North American Great Lakes: Assessing species sensitivity to environmental mixtures

S. Knoho, St. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; U. Hasbay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concern (CECs) have been detected ubiquitously in aquatic environments, 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 addition to estrogenicities, while minnow ESR1 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate the estrogen receptors (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, while minnow ESR1 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate either allighor or human 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 isofoms 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 either allighor or 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.

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Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures
U. Hasbany, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concern (CEC), including pharmaceuticals, personal care products and industrial agents may impact aquatic life. Previous studies have documented endocrine disrupting effects in fathead minnow larvae exposed to diverse CECs. However, these studies did not consider the complex mixtures of CEC present in the environment. The purpose of the current study was to understand the change on apical endpoints as the complexity of CEC mixtures increases. We tested the hypothesis that as the complexity of CECs in exposures increase, the apical endpoints observed will differentiate from simple exposure endpoints. We assessed the potential of 21 commonly detected CECs on three life stages fathead minnows: embryo (developmental abnormalities, transcriptomics), juvenile (survival, escape performance, feeding efficiency, qPCR) and adult (survival, secondary sex characteristics, nest defense, courtship, boldness, qPCR) after 96-hour flow-through exposures. In addition, we began the process of building a series of complex mixtures to study the CEC effects using neural network methodology. Individual compound concentrations and mixture composition were based on an analysis of nearly 500 water samples collected as part of the Great Lakes Restoration Initiative. Our current findings show that the larval survival was significantly reduced (p < 0.05, ANOVA) by diverse CECs including estrone, desvenlafaxine, and tris(2-butoxethyl) phosphate exposures. Interestingly, exposure to ibuprofen showed a potential therapeutic effect at the medium concentration to assess two divergent treatment technologies of wastewater and also suggested evidence of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of fathead minnows and forming a linkage between behavioral responses and adverse outcomes.

TH059 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-Weigel, University of St. Thomas / Biology; P. Edmiston, 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/dechlorination). The receiving aquatic ecosystems 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 of wastewater and also suggests evidence of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of 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.E. Reear, German Federal Institute of Hydrology; L. Moscović, The Hebrew University of Jerusalem / Institute of Life Sciences, Department of Plant and Environmental Sciences; M. Reiter, for the detection F of a series of biological endpoints: S. Belkin, D. Shalit, The Hebrew University of Jerusalem; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology Organic micro-pollutants (MPs) can enter the aquatic environment via diverse pathways and sources such as waste water treatment effluents, agricultural activities or the disposal of various consumer goods. Tracking the occurrence, distribution and fate of these substances is a challenge in aquatic ecosystems. The Metabolic Fingerprinting (MFinger) project [1] [2] [3] [4] aims to use metabolomics to perform a comprehensive assessment of the effect of these contaminants on the aquatic biota. The project “TREES” [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 biological effects. 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) biocandidate bioreactors. 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 different biological endpoints (UV; qPCR) dechlorination and qPCR) to determine the possible transformation products (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed using various reference compounds. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of appropriate sensor-strains as well as simultaneous monitoring of additional endpoints (eco)toxicological effects and (iii) method development for the detection of compounds by chemical analysis after separation by HPTLC. <br 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: 02WIL1387.

TH062 Endocrine disruptors used in polymers in the offshore oil and gas industry C. Phillips, Cefas Lowestoft Laboratory / Science Directorate - advice and assessment; R. Suering, 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. A leach endocrine disruption test in more weathered conditions was required to determine more accurately the potential for releasing EDs and 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 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.
Th063 Thyroid disorder screening using zebrafish as vertebrate model
I. Iturri, O. Jaka, C. Martí, A. Alzuade, BioBide; A. Muriana, BBB 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 polycyclic aromatic hydrocarbons, 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-detection 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 cytokerin 8-knob assay in line with the 3R principles in relation to 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.

Th064 Development of stably transfected cell lines with zebra fish thyroid hormone receptors alfa and beta for assessing endocrine disruption in environmental samples
V. del Villar Herranz, INIA National Institute for Agricultural and Food Research and Technology; E. Sánchez Martínez, Instituto de Aguacultura 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. Cerdá Reverter, Instituto de Aguacultura 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 use of reporter gene assays in line with the 3R principles in relation to 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.

Th065 Screening endocrine disrupting potentials of alternative plasticizers using thyroid hormone receptor assays
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 dihexylhexyl 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 tests doses for each plasticizers applied were determined based on preliminary cytotoxicity assays for each cell line. While none of alternative plasticizers showed significant estrogenic or androgenic affinity in MVLN cells. DINCH and DEHA exhibited significant increase in estradiol (E2) to testosteron (T) ratio in H295R cells. This results suggest that these plasticizers DINCH and DEHA cause increased estrogenicity through altering steroidogenic pathway, similar to DEHP. In GH3 cell line, shh 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.

Th066 Development of reporter gene system for assessing cherry shrimp ecdysone eyecord 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

Ecdysoid 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 complex which comprises the ecdysone receptor (EcR) and retinoid X receptor (RXR). The activated complex anchoring on the ecdysone responsive element (EcoRE) 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 aryl-hydrazone derived DAH (1,2-dihydroxyanthraquinone) were developed to disrupt eyecord/receptor signalling. They work as the eyecord receptor antagonists, which cause premature launching of the molting process and subsequently death. Crustaceans, as a subphylum closely related to insects phyleogenetically, also adopt this ecdysene 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 post a threat on the crustaceans. Here we report the development of an in vitro reporter assay for the screening of eyecord 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 EcoRE. The results show that the system responses well to the native ecdysones hormones in a dosage-dependent manner. The adaptation of mammalian cells in 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.

Th067 Micro-injection as an alternative for aquatic exposure? A case study in zebrafish embryos with 17α-ethinylestradiol
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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 done in vitro using expression assays with medium throughput. In this study, 17α-ethinylestradiol (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 vtg l. 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

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Atrazine, a widely used herbicide, has been categorized as a suspected endocrine disrupting agent 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. Further investigations in the hepatopancreas revealed that, together, our data showed that atrazine exposure was able to inhibit vitellogenin production in the crayfish P. clarkii, altering on the other hand the normal balance of sex steroids.

TH069
Identification of molt-inhibiting hormone and ecdysteroid receptor sequences in the crayfish Procambarus clarkii and consequences of endocrine disruptor exposures

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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 key part of the aquatic ecosystems, such as crayfish, 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 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-qPCR in Gammarus pulex and consequent to EE2 exposure from both routes, while vitellogenin (vtg) expression only in uninfected gammarids. This work allowed to determine the sili- microsporidia VT appeared to be a confounding factor which could lead to misinterpretation the endocrine risk assessment. Finally, results the promising in the development of PE biomarkers in invertebrates, since this is a tool that is currently missing. However, further studies will be needed to study the variations of these genes and understand their regulational, before to use them as biomarkers.

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

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Chironomus riparius is a species of the family Chironomidae, which are invertebrates species of Gammarus pulex in some rivers, which are 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 endocrine disrupting chemical (EDC) toxicants are not able to determine the silicate content of EE2, it is expected to adsorb to organic matter and accumulate in sediment. However, little is known about the effects of sediment-bound EE2 on sediment-dwelling organisms. In the present study, the effects of EE2 were investigated on the freshwater benthic invertebrate, Chironomus riparius, in a long-term sediment-water toxicity test using formulated EE2-spiked sediment and field sediments. 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 silica sand, kaolin clay and peat moss to match the sediment types of the Luppe and Wurm/Inde. Each formulated sediment type was used in the negative control, a silicone O-ring was chosen as a reservoir for dosing BPA to Daphnia magna. The uptake and retention kinetic of BPA on the O-ring were measured 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 was tested by spiking BPA dissolved in methanol (0.01%) was conducted with the same range of concentrations (0-10 mg/L). Through the passive dosing method, we were able to determine the silicate-water partition coefficient of BPA and control silicate 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 Kow 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 arthropod, and they are the major constituents to aquatic ecosystems that provide a variety of ecological and economic services. Nowadays, 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 disrupters known to interfere with the natural hormone action in insects by mimicking the juvenile hormones. However, the structure and functions of the methyl farnesol (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 JHJ insecticides - methoprene and fenoxycarb on a freshwater shrimp Neocaridina davidi which is successfully cultured 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) of fenoxycarb and methoprene were 1.40, 0.97 µg/L (4.6, 3.20 µmol/L) and 1.96, 1.26 µg/L (6.32, 4.06 µmol/L) methoprene, the body length decreased by 20.5% and 11.8% as compared to control, respectively. And the total number of molts of 20 shrimp over this period reduced by 29.2% and 17.7%. Differential expressions of JH signaling pathway genes were investigated in this study. The genes h3 (hormone receptor 3) and e74 in N. davidi were up-regulated, while Chd64 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydrolase) and JHMT (JH acid methyltransferase) were down-regulated in shrimp treated with fenoxycarb and methoprene. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH075 Development of Multimedia Fate Model for Human Risk Assessment of EDCs in the Asan Lake Watershed, Korea M. Choi, J. Kim, Greeencos Inc.; Y. Kim, Greeencos Inc.; CEO Multimedia fate model (multimedia fate model for H/man Risk Assessment in Multimedia Environment) has been developed considering topographic features and environmental and been meteorological data of watershed region of Asan Lake in Korea. Human risk assessment system using this multimedia fate model was established and integrated to assess spatial exposure and risk about human living in this area. For this purpose, first, GIS database system containing environmental data of the watershed region was established. The topographical data and meteorological data of hazardous chemicals was developed. Second, Environmental concentrations of various chemicals were predicted, applying different fate processes according to different chemical properties. Third, advection and dispersion by wind in air grids, runoff in watershed, flows of water in water segments are considered in the watershed-based multimedia fate model, which was linked to a risk assessment system using the employed multimedia fate model, and models of multimedia (Endocrine Disrupting Chemicals) and assesses human risk in this area. HURAME is valuable tools for predicting the fate of chemicals in evaluative and real environments with areas consisting of many watersheds. These models are an integral component of exposure assessment and risk assessment strategies, and are used in detailed assessments of contaminant fate. The aim of these models is to describe quantitatively contaminant fate and migration in a defined watershed region, with water segments and air grids inside of the region of interest treated more complicatedly. As a result, regional levels of environmental contamination are controlled by environmental parameters and processes and meaningful evaluation requires assessment of contaminant fate in neighboring regions. A linked set of regional models is the potential to describe quantitatively the impact of chemical emissions over a wider geographic scale with significant spatial differences in environmental characteristics and chemical use patterns.

TH076 Sensitive Biomarker Assay using LC-MS/MS: Determination of Thyroid Hormones (T3 and T4) in Fetus, Pup and Adult Rat Serum - Sampling Considerations S. Diaram, Enviro / Bioanalysis (LC-MS/MS) The regulatory need for the analysis of circulating levels of thyroid hormones in rats (fetus, pup and adult) on reproductive toxicology studies has prompted the need for a sensitive assay for T3 and T4, which could not be fulfilled when using the traditional radioimmunoassay (RIA) format. A new method validated using a liquid chromatography tandem mass spectrometry approach for the quantification (LLOQ) of 5 pg/mL for T3 (final range 5 to 1500 pg/mL), and a final range of 70 to 70 0000 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 it was observed that a different protocol is required for the clotting process to generate the serum sample (a) plain plastic tubes and (b) tubes containing clot activator). A trend was observed in samples obtained using plain tubes for the clotting process resulting in suppressed analytical instrument responses. Hence an appropriately labelled internal standard is imperative, however this does not safeguard data points where low pg/mL concentration levels are measured. In the samples, values were particularly prevalent in fetus and Day 4 of age pups. Considering that samples are collected from animals of fetus and Day 4 of age pups, which may be triggered for analysis subsequent to Day 13 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 $\leq 20\%$ (25\% for the LLOQ) demonstrating that tubes containing clot activator can be used for T3 and T4 sampling.

TH077 Steroid estrogens and estrogenicity as a ubiquitous threat in dairy farm watersheds regardless of effluent management practices

L.A. Tremblay, Catchword 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 allowed direct input of DSE into waterways and runoff from land application all require discharged into waterways. This results in the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

TH078 Toxic receipt: Why You Should Avoid it?

J. Milad, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randjelovic, L. Šoćic, 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 activity 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: Eeq) was found in low levels in 85% of the stream samples (highest 1.44 ng L$^{-1}$, Eeq) and with no 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.

TH079 SETAC Endocrine Disruptor Testing and Risk Assessment Interest Group

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science (P)

TH080 Evaluate the ecological risk during product development: safe by design case study - Met@link project

R. Cornet, VITO / ABB; T. Geerts, VITO NV / Health; S. Verstraeten, VITO / ABS

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). Environmental risk assessment (ERA) is performed to assess 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 effects and concern? Literature data learn that Ag-NP particles are indeed highly toxic to 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 ecotoxic 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. Ariis, ARCHE; J. Mertens, Precious Metals and Rheinum Consortium c/o EPFM

As part of the REACH Substance Evaluation for silver, new data was required to be generated in order to further justify the read-across from ionic silver to silver nanoparticle (Ag-NP). Information on aquatic and soil ecotoxicity of the smallest silver nanoform with the highest specific surface area registered under REACH as compared to ionic silver. The tested nanoform 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 nanoform registered under REACH. Ag-NP 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 alga 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) where silver was less toxic than silver nitrate. Toxicity 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 nanoform was fully characterised (aqueous suspensions containing approximately 37% nanoparticles with spheroidal-like shape, mean primary particle size 9.4 nm). The dissolution behaviour of the tested silver nanoform 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 silver nitrate, further fate testing in soil was not required. The data collection on the uses of the silver nanoforms 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. Sørensen, DTU Environment / DTU Environment; L. Skjølding, DTU / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Banger, Technical Institute / DTU Environment; M. Nybo Andersen, VITO / ABS

The European Safer Chemicals, Safer Society (SC4S) project (2014-2017) provides innovative approaches and solutions for safer chemicals, materials and products in Europe. From this project, the Environmental 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
in suspension is fundamentally different from that of chemicals in solution. In the aim of this paper is to present the findings of the EnvNano project and through these provide the scientific background for specific recommendations on how ECHA guidance could be further improved. Key EnvNano findings such as the need to characterize dispersion and dissolution rates in stock and test media have partially been addressed in the updated guidance. However, it has to be made clear that multiple characterization methods have to be applied to describe state of dispersion and dissolution over time and for various test concentrations. More detailed information is called for on the specific characterization methods and techniques available and their pros and cons. Based on findings in EnvNano, we recommend that existing algal tests are supplemented with tests where suspensions of nanomaterials are aged for 1-3 days for nanomaterials that dissolve in testing media. Likewise, for daphnia we suggest to supplement with tests where a) exposure is shortened to a 3h pulse exposure in daphnia toxicity tests with environmentally hazardous metal and metal oxide nanomaterials prone to dissolution; and b) food abundance is three to five times higher than normal, respectively. We further suggest that the importance of considering the impact of shading in algal tests is made more detailed in the guidance and that it is specified that determination of uptake, depuration and transfer of nano materials for each commercialized functionalization of the nanomaterials is required. Finally, as an outcome of the project a method for assessing the regulatory adequacy of ecotoxicological studies of nanomaterials is proposed. TH083 Identifying criteria for environmental risk assessment models at different stage-gates of nano-material/product innovation considering requirements of various stakeholders S. N. Sørensen, DTU Environment / DTU Environment; S. F. Hansen, A. Baun, Technical University of Denmark / DTU Environment; D. Spurgeon, Centre for Ecology & Hydrology; M. Matzke, NERC Centre for Ecology and Hydrology; K. Schellnhuber, Potsdam Institute for Climate Change Research; T. Kuhlbusch, Eawag Swiss Water Science / Southern Ocean Persistent Organic Pollution Program; M. Dal Maso, M. Poikikimaki, Tampere University of Technology / Aerosol Physics; A. Verschoor, RIVM / Centre for Safety of Substances and Products; J.T. Quik, RIVM / DMG; W. Peijnenburg, RIVM / Center for Safety of Substances and Products; H. Wigger, Empa - Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, Empa - Swiss Federal Laboratories for Materials Science and Technology / Technology and Society Lab The EU H2020 project calibrate aims to establish a state-of-the-art versatile risk governance framework for assessment and management of human and environmental risks of manufactured nanoparticles (MN) and MN-enabled products in the innovation process. The aims of these materials and products. Initial efforts have focused on identifying criteria for environmental risk assessment (ERA) models and tools for such governance framework. It was recognized that some criteria are applicable to both environmental and human risk assessment (HRA), and these so-called “overall” criteria were identified through joint efforts of the ERA and HRA working group experts in callIBRate. The identified “overall” criteria relate to RA model features and resources needed to use the tools, whereas the criteria specific to ERA models relate to model outcome on hazard, exposure and risks. The identified criteria were listed against the Cooper stage-gates®, thus forming a table in which the importance or relevance of each criterion could be assessed for each of the stage-gates. This was formed into questionnaires with defined response options for each environmental or human risk assessment (HRA) model design and implementation. The questionnaires were sent to stakeholders representing regulators, consultants, researchers and industries, who provided their feedback, either by filling the questionnaires or by listing general input on their current RA approaches or needs. Efforts to obtain input from NGOs and insurers remain ongoing. The feedback clearly illustrated different requirements between stakeholder groups. For example, not all use the (same) stage-gate approach or have the same level of expertise for RA. Other criteria were similar or similarly important to most stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria suggested useful for users by callIBRAté partners included the use of material/estimation of safety-by-design considerations as low cost options to identify “red flags” for hazard and/or exposure at early stage-gates of MN innovation. The criteria and stakeholder feedback generated will be applied to evaluate existing models/tools against, but also to enable the creation of a “System of systems” for RA along stage-gates when developing MN and MN-enabled products, incorporating the needs of different specific user groups. TH084 Considerations of nanomaterial’s environmental fate to support grouping and environmental risk prediction M. Herchen, Fraunhofer IGE; C. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; K. Schwim, German Federal Environment Agency UBA; T. Kuhlbusch, BBAuA; C. Asbach, Institute of Energy and Environmental Technology eV IUTA TH085 Matrix to predict possible environmental risk of nanomaterials during use M. Herchen, Fraunhofer IGE; K. Hund-Rinke, Fraunhofer IGE / Department of Ecotoxicology; C. Nickel, Institute of Energy and Environmental Technology eV - IUTA / Air Quality & Sustainable Nanotechnology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; K. Schwimm, German Federal Environment Agency UBA; T. Kuhlbusch, BBAuA Grouping of engineered nanomaterials (ENMs) is a strategy in environmental risk assessment that should allow an adequate hazard assessment while reducing the testing effort needed for a material-by-material fate and effects testing. We present a practicable matrix that allows to group of ENMs regarding their potential risk to the aquatic and terrestrial environment. This matrix is based on the combination of assumptions regarding release and fate as well as ecotoxicological effect. The assumption the fate factors are based on the (release) an compound with the property of hazardous chemical, ecotoxicological effect properties (ecotox bond; present at an additional poster) of 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.: 03XP0002 TH086 Concepts for nanomaterial categories regarding environmental hazard and for prediction of their environmental risk as well as proof of principle K. Hund-Rinke, Fraunhofer IGE / Department of Ecotoxicology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; C. Nickel, Institute of Energy and Environmental Technology eV - IUTA / Air Quality & Sustainable Nanotechnology; K. Schwimm, German Federal Environment Agency UBA; D. Volker, German Environment Agency; E. van der Zalm, German Federal
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 physicochemical (PC) properties, i.e. morphology and size, as well as ecotoxicological parameters 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 points, where the property morphology is defined by three categories i.e. fibers, small spherical ENMs, others. The ecotoxicity of the ENMs of a specific group is attributed to similar PC-properties thus support discussion on grouping with the final objective of read across. Approach II (ecotox-bond) was developed for risk assessment by using an approach similar to control banding. For risk assessment the hazard information has to be combined with properties influencing environmental fate, 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 or band 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 release where the properties that have been subjected to leaching or 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

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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 (PMDA) for modelling the proportions of nano-Ag and nano-TiO₂ flowing in different forms such as 1) not having been subjected to environmental fate, 2) being matrix-embedded, 3) nanoparticulate (non-transformed, not embedded ENM including free, aggregated and agglomerated ENMs) and 4) 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. The method models four 10-year time periods 1) construction and use of ENM-containing 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 these 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 was occurrence of crystallization and transformation of nanofibers in which ENMs 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. Sloatweg, 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 model, the transformation efficiency, as 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 SimpleBox4-nano: 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

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There is an increasing need for predictive risk assessment of nanomaterials (NMs) as these ENMs are released to the environment in different forms that are not specific cases. In order to estimate the release of NMs into the environment, different approaches can be used. 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.

**TH090**

NanoScreen - Minimizing the risk associated with nanomaterials used in sunscreen at all lifecycle stages

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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, and thus the UV blocking 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 development of methods and tools for evaluating the environmental risks 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 bioavailability 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 number 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 sunscreen 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.

**TH091**

Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials

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A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel Corbicula fluminea.


In order to illustrate the effort of TG/GD development the way from the OECD Test Guidelines and Guidance Documents for Environmental Safety to an accepted OECD TG/GD guideline will be given to an idea for a new TG and new GD to an accepted OECD TG/GD guideline will be presented.

TH092

Applicability of OECD fish bioaccumulation test guideline 305 to nanomaterials.

J. Navas, A. Bermejo-Nogales, INIA - National Institute for Agricultural and Food Research and Technology / Department of Environment; M. Fernandez, E. Conde, I. Rucandio, CIEMAT; M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment Agency UBA.

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) are 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 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 both in mussels and in crustaceans. 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 mass of silver in water and mussels was performed by ICP-MS or ICP-OES. The determination of the mass 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.

TH094

Genotoxicity of ZnO nanoparticles. A comparison of methods, tools and mechanisms of action in test experimental models used for human and ecological risk assessment.

s. marzio, ENEA / SSPT-PROTER-BES; s. sciava, ENEA CR; M. Oltiviero, University of Parthenope; F. Pacchietotti, ENEA; c. angelloni, ENEA CR; E. Cordelini, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; g. leter, TECS.

ZnO nanoparticles are considered among the most toxic ones mainly for their capability to dissolve toxic ions. They are largely employed in many productive sectors and primarily in personal care product formulations and then represent a real threat for humans under flow-through conditions. First studies were carried out and human health threat posed by engineered nanomaterials (ENM) need a dialogue between toxicologists and ecotoxicologists in order to get a comprehensive understanding of the adverse outcome pathways and to reach a consensus on safe limits for both humans and the environment. Generally, toxicity testing imply the evaluation of multiple endpoints and, especially in ecotoxicological studies, of and tissue samples was carried out by ICP-MS or ICP-OES. The determination of the mass 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.

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Biochars are thus a promising and economic alternative to other carbonaceous materials for the treatment of industrial contaminated soils. Increasing the sorption of metals as compared to non-biochar contaminated soils might reveal differential instrument matrix effects or unexplained variability. The present work aimed at assessing the applicability of the TOP assay in the evaluation of oxidation yields in the various matrixes assayed, as well as a careful assessment of the matrix effect that may occur at the instrumental analysis stage. The method was applied to a limited survey of surface water and groundwater samples. It was observed that even though fluorotelomer sulfonates (FTSAs) were the target pre-PFAs predominantly reported before oxidation in most instances, they could only partially account for the observed APFAA (molar concentration increases upon oxidation). The unexplained APFAA portion likely results from the oxidation of untargeted pre-PFAs for which oxidation yields are yet to be determined.

The global distribution of certain perfluoralkyl and polyfluoralkyl substances (PFASs) in the environment is of concern given their environmental persistence and bioaccumulative properties. The objective of this study was to examine the sorption of a variety of PFASs (perfluoralkyl acid and alkyl ammonium) to impacted soils sites from a fluorochemical production plant and to correlate BC properties (surface area, isopods, etc.) with the sorption of both organic and inorganic pollutants 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 soils, ii) whether BC can sorb 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.

The sorption of 14 PFASs to organic soil constituents - the effect of H+, Na+, Ca2+ and Al3+ ions

The global distribution of certain perfluoralkyl and polyfluoralkyl substances (PFASs) in the environment is of concern given their environmental persistence and bioaccumulative properties. The objective of this study was to examine the sorption of a variety of PFASs (perfluoralkyl acid and alkyl ammonium) to impacted soils sites from a fluorochemical production plant and to correlate BC properties (surface area, isopods, etc.) with the sorption of both organic and inorganic pollutants 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 soils, ii) whether BC can sorb 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.

Biochars are thus a promising and economic alternative to other carbonaceous materials for the treatment of industrial contaminated soils. Isotopes 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 and PFPAAs concentrations in soil, as well as correlations between PFPAAs 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 PFOA 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
Perfluoroalkane sulfonamidoacetic acids (FASAAs) are to the best of our knowledge, novel compounds. They are of growing concern worldwide, due to the linkage of these compounds to adverse effects in humans and the environment. Surface water in the northeastern United States in particular have been known to contain elevated concentrations of PFASs. Here we use passive samplers to gain a better understanding of the sources and spread of these contaminants. Thirty-two microporous polyethylene (PE) passive samplers (containing Hydrophilic–Lipophilic–Balanced sorbent) were deployed across nine sites in Narragansett Bay (RI, USA) in the fall of 2017 for a one month duration each. Deployment sites ranged from wastewater treatment plant and industrial outfall, to recreational and fire training bases, and more pristine areas. 25 PFASs (including perfluorinated sulfonates, carboxylic acids, and GenX) were measured across all sites in the passive samplers, as well as water and sediment samples. For a more direct point source evaluation, 10 additional samplers were deployed in two waste water treatment plants of a large urban area. By analyzing the spatial and temporal trends of these fluorinated compounds we plan to assess their longevity in water and sediment of the Bay. Lastly, we aim to understand and predict potential effects on the environment and better advise on regulatory practices.

Distribution of per and polyfluoralkyl substances in sediments of the Spanish coast

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Per- and polyfluoralkyl substances (PFASs) configuration, consisting in an alkylated hydrophobic chain fully or partially fluorinated, hydrophilic group terminated, provides to PFASs simultaneous hydrophobicity and lipophobicity. Their persistence, bioaccumulation and toxicity make them a source of increasing environmental and public health concern. Presence of PFASs in the environment is caused by discharges of wastewater effluents or river flows, urban runoff, atmospheric deposition of volatile precursors and subsequent transformation, or direct application of fire-fighting foams containing PFASs, among others. Samples were collected in two semi-confined coastal areas, one of them an area with high industrial and port activities (Ría de Vigo) and the other one with high touristic and recreational activities (Mar Menor). Some characteristic of the sediments were taken into account in order to find the correlation between these parameters and the obtained data. Moreover, the environmental risk was evaluated. Acknowledgements: Financial support by the Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) (reference: ED431C 2017/28) potentially co-financed by ERDF, and by the Ministry of Economy and Competitiveness (MCI), project reference: CTM2013-48194-C3-1-R/R-Z, and ARPA-ACUA, project reference: CTM2016-77945-C3-3-R. References: Concha-Graña E. et al., VIII Reunión de la Sociedad Española de Espectrometría de masas, V Reunión Nacional de Dioxinas, P. López-Mañá, Universidad de Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); L. Viñas, Instituto Español de Oceanografía / Centro Oceanográfico de Vigo; J.A. Campillo, Instituto Español de Oceanografía / Centro Oceanográfico de Murcia; S. Munuera, Universidad de Coruña / Analytical Chemistry Department

Utilization of passive samplers to detect per- and polyfluoralkyl substances (PFASs) in wastewater treatment plants

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Poly- and perfluoralkyl substances (PFASs) are of growing concern worldwide, due to the linkage of these compounds to adverse effects in humans and the environment. Surface waters in the northeastern United States in particular have displayed elevated concentrations of PFASs. Here we use passive samplers to gain a better understanding of the sources and spread of these contaminants. Thirty-two microporous polyethylene (PE) passive samplers (containing Hydrophilic–Lipophilic–Balanced sorbent) were deployed across nine sites in Narragansett Bay (RI, USA) in the fall of 2017 for a one month duration each. Deployment sites ranged from wastewater treatment plant and industrial outfall, to recreational and fire training bases, and more pristine areas. 25 PFASs (including perfluorinated sulfonates, carboxylic acids, and GenX) were measured across all sites in the passive samplers, as well as water and sediment samples. For a more direct point source evaluation, 10 additional samplers were deployed in two waste water treatment plants of a large urban area. By analyzing the spatial and temporal trends of these fluorinated compounds we plan to assess their longevity in water and sediment of the Bay. Lastly, we aim to understand and predict potential effects on the environment and better advise on regulatory practices.

Utilization of Polyethylene Passive Samplers to Detect volatile PFAS precursors in water and air

E. Dixon-Anderson, R. Lohmann, University of Rhode Island / Graduate School of Oceanography
Occurrence and Removal of perfluoroalkyl and polyfluoroalkyl substances (PFASs) in full-scale water and wastewater treatment plants

H. C. L. S. Rahman, P. M. G. Shabir, S. Martin, National University of Singapore / Civil & Environmental Engineering

Perfluoroalkyl and polyfluoroalkyl 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, bioaccumulative capability and toxicological effects on organisms. 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 (PFOAs) and 11 PFNA precursors. The treatment processes include conventional activated sludge system (CAS) and membrane bioreactor (MBR) system in plant 1, sand filtration (SF) and membrane bioreactor (MBR) system in plant 2, and hybrid treatment plant (HWT) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyfluorocarbon-water partitioning constants, log K_{ow}, during the 3-week uptake experiments. Derived log K_{ow} values for 6, 8 and 10 PFOA’s were 3.5, 4.6 and 4.8, respectively. For PFNA and PFOS, derived log K_{ow} 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 of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in biota in Czech rivers

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The objective of the Study is the comparison of PFOS and PFOA concentrations in biota in Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses (Czech Republic). The study compared the use of polyethylene passive samplers as a technique to collect data on PFAS concentrations in biota. This study assessed the use of polyethylene passive samplers as a sampling technique for volatile PFAS precursors coupled to their analysis via gas chromatography-mass spectrometry (GC/MS). Parallel active and passive sampling was performed at ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 ppmv), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{ow}, during the 3-week uptake experiments. Derived log K_{ow} values for 6,8,10 FTOH’s were 3.8, 4.5 and 4.8, respectively. For PFNA and PFOS, derived log K_{ow} 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.

TH106

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers

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The objective of the Study is the comparison of PFOS and PFOA concentrations in biota in Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses (Czech Republic). The study compared the use of polyethylene passive samplers as a technique to collect data on PFAS concentrations in biota. This study assessed the use of polyethylene passive samplers as a sampling technique for volatile PFAS precursors coupled to their analysis via gas chromatography-mass spectrometry (GC/MS). Parallel active and passive sampling was performed at ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 ppmv), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log K_{ow}, during the 3-week uptake experiments. Derived log K_{ow} values for 6,8,10 FTOH’s were 3.8, 4.5 and 4.8, respectively. For PFNA and PFOS, derived log K_{ow} 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.
precursors to the apparent biomagnification of PFCAAs, via their biotransformation. In addition, the Total Oxidizable 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 M. Jedrzejewski, F. Fraunhofer IME Environmental and Food Analysis; M.W. Bücking, F. Fraunhofer IME Institute for Molecular Biology and Applied Ecology / Environmental and Food Analysis; H. Ruedel, F. Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; J. Koschorreck, Umweltbundesamt Per- and Polyfluorinated Substances (PFAS) have been an ongoing challenge for the environmental 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 by new molecules from international markets, that already travel around the world in order to substitute or as ingredients of rainbow trout. 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 PFSA), and also precursors (e.g. PAPs, diPAPs, FTS, NAHDONA) 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 (Onchorhyncus mykiss) A. Vidal, I. Seatra Lyon; R. Beaudoin, INERIS / Models for Ecotoxicology and Toxicology METO; E. Vulliet, CNR5 / TRACES Team; E. Rochard, I. Seatra Bordeaux / UR EABX; J. Garric, I. Seatra Lyon / UR RIVERLY Laboratoire Ecolinguistique; D. Savi, I. Seatra Lyon / UR RIVERLY Per- and poly-fluorinated substances (PFASs) are ubiquitous in the environment, specifically in aquatic systems. While several PFASs are acknowledged to be bioaccumulated by vertebrate species, including fish, their absorption, distribution, metabolisation and elimination (ADME) remain incompletely understood yet. The aim of this study is to develop a physiologically based toxicokinetic (PBTK) model in rainbow trout to describe the uptake, distribution, and elimination (PFOS< PFHxS< PFOA< PFBA). Chemical control concentrations were reached at 120 hpf for all PFAAs tested, ruling out unspecific loss due to experimental conditions. The functional group of PFAAs, in addition to the alkyl chain length, may have an important influence on the toxicokinetic processes.

TH111 Does water temperature influence the toxicokinetics of perfluorinated substances? Comparison of two dietary experiments in rainbow trout (Oncorhyncus mykiss) A. Vidal, I. Seatra Lyon; L. Espinat, IRCA; C. Gesset, P. Chèvre, I. Seatra / UR EABX; F. Lafay, Institut des Sciences Analytiques / TRACES; E. Rochard, I. Seatra Bordeaux / UR EABX; J. Garric, I. Seatra Lyon / UR RIVERLY Laboratoire Ecolinguistique; M.P. Babut, I. Seatra / Water Per- and poly-fluorinated substances (PFASs) are widely found in fresh and marine water environments and accumulate in aquatic organisms. Fish are poïkilotherms and subject to large seasonal changes of temperature, which control physiological processes such as feeding, respiration, fecal egestion, and ultimately growth. Absorption, metabolism, distribution and elimination (ADME) are concerned as well. For accurate predictions of organic contaminants bioaccumulation it is therefore important to take into account temperature variations. Also, to our knowledge, no study on the effect of the temperature on the ADME of PFASs in fish has been carried out yet. The aim of this work is to determine to which extent temperature affects absorption and elimination rates, and distribution within the fish body. Two perfluorinated acid compounds, namely perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (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 trout (O. mykiss) at two water temperatures (7°C and 16°C). In both experiments fish were fed ad libitum with non-contaminated diets. 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. Comparison of two dietary experiments, as well as this obtained from the TK experiments differed by four orders of magnitude (PFOS< PFHxS< PFOA). Chemical control concentrations remained constant until 120 hpf for all PFAAs tested, ruling out unspecific loss due to adsorption to glass. The time courses of the internal concentrations in ZFEs indicated biphasic uptake kinetics with slow uptake before hatchmogen to 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 within 120 hpf. Moreover, PFOS 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.

TH112 Toxicokinetics of perfluorinated alkyl acids in zebrafish embryo C. Vos, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Environmental Medicine; M. Näslund, S. Wulff, Karolinska Institutet / Institute of Environmental Medicine IMM; M. Sjödin, M. Hellstrandh, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Center Perfluorinated alkyl acids (PFAs) are widely distributed and have been detected e.g. in humans, wildlife and numerous other environmental matrices. These surfactants are highly bioaccumulative as well as persistent and have been associated with several health effects including hepatotoxicity, immunotoxicity and developmental toxicity. The chemical structure of PFAs mainly differ in two ways: the length of the hydrophobic alkyl chain and the hydrophilic end groups. Little or nothing is known how the structure affects the toxicokinetics (TK) (uptake, distribution, biotransformation, elimination) and, consequently, the toxic effects in different organisms. We therefore studied the TK of four PFAAs; perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS) and perfluorobutanoic acid (PFBA) in the gynogenetic zebrafish (Danio rerio). Two TK experiments were run to apply two large scale multi methods capturing short (e.g. C2 to C6 PFAA), medium and long chain PFAA (e.g. C6 to C14 PFAS and PFSA), and also precursors (e.g. PAPs, diPAPs, FTS, NAHDONA) 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.

TH113 Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFPO-DA M. Vesterberg, RIVM Institute for Safety and Environment for Substances and Products; E. Smit, RIVM / Centre for Safety of Substances and Products; P. Wassenaar, National Institute for Public Health and the Environment (RIVM) Environmental risk limits (ERLs) were derived in the Netherlands for the substances perfluorooctanoic acid (PFOA) and hexafluoropropane oxide dimer acid (HFPO-DA); also referred to as GenX, FROD-902 or PFOSmmon). The 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 amply available for PFOA, but is very scarce for HFPO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.
The bioaccumulation factors in the aquatic environment appeared to be dependent on the exposure concentration. For both the terrestrial and aquatic food chain, the specific protein-binding behaviour of PFOA requires different methods for normalisation of the concentration values, than those normally applied to hydrophobic substances, i.e. based on lipid and organic carbon. Not only exposure via food, but also the human toxicological threshold value of PFOA itself is determined by protein binding. Higher serum concentrations are needed because of the difference in toxicokinetic half-live between humans and laboratory animals, like rats and mice. For HFPO-DA kinetic data are only limited, which hampers the derivation of a human-toxicological threshold. It is further investigated based on the available data for both substances whether these findings for PFOA can be extrapolated to HFPO-DA, taking into account the structural differences between both compounds. Additional experimental bioaccumulation data for HFPO-DA is probably needed to complete the ERL derivation.

**TH114**

Perfluoroether carboxylic acids - are these substances appropriate PFOA-alternatives regarding their environmental concerns?

C. Stuhler, G confer, S. W. Engler, German Environment Agency - UBA / Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; L. Vierke, German Environment Agency / Chemicals Perfluorooctanoic acid (PFOA) is a persistent, bioaccumulative and toxic substance. To minimize the exposure of humans and environment a restriction according to REACH will come into force in the EU in 2020. For a global restriction of PFOA alternatives will be considered within the context of the Minamata Convention on Mercury in 2019. However, studies conducted recently in humans indicate that dissolved perfluoroether carboxylic acids in the blood and urine of humans are present at levels that suggest a health risk.

The uses of PFOA as processing aid in fluoropolymer production has been mainly substituted with perfluoroether carboxylic acids (PFECA). PFECA are structurally similar to perfluorooalkyl carboxylic acids such as perfluorooctanoic acid (PFOA). Due to this structural similarity it could be expected that PFECA are equally hazardous to the environment. Thus, the German Environment Agency has assessed the environmental hazards in the context of substance evaluations under REACH for certain PFECA such as ADONA (ammonium 2,2,3,3- trifluor-1-(1,2,2,3,3-hexafluoro-3-trifluoromethylpropoxy), propionate) and GenX (ammonium 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy) propane). The post will present a summary of the substance evaluations. PFECA are expected to be very persistent under environmental conditions. The substances have a low bioaccumulation potential in aqueous organisms. However, just as PFOA, PFECA may not fit into the common accumulation pattern. Furthermore, the substances are probably mobile in the aquatic environment and can reach groundwater and consequently drinking water resources. PFECA have already been detected in surface water, groundwater and drinking water around fluoropolymer production plants [1–4]. In conclusion, further data are necessary, but the available information on PFECA already demonstrates that these substances are hazardous for the environment and further risk management measures are needed. [1] Gebbink WA, van Assem, M. L., van Leeuwen M. SP., 2017. Environ. Sci. Technol. Lett. 4: P075-11065 [2] Sun M, Arevalo E, Strynar M, Lindstrom A, Richardson M, Kearns B, Pickett A, Smith C, Knappe DRU. 2016. Environ. Sci. Technol. Lett. 3: 415-419 [3] Schreiber J. 2014. Untersuchung des Transportverhaltens von ADONA in Boden und Grundwasser anhand von Feld- und Laborstudien. Diploma thesis [4] Heydeldreck F, Tang J, Xie Z, Ebinghaus R. 2015. Environ. Sci. Technol. 49: 8386-8395: 49: 14742-14743

**TH115**

Fluoropolymers: Polymeric PFAS That Satisfy Global Polymer of Low Concern Criteria

B. Henry, W. L. Gore & Associates, Inc. Fluoropolymers, such as polytetrafluoroethylene (PTFE), constitute a distinct class within the polymeric category of the PFAS group. Fluoropolymers are resistant to chemical, hydrolytic, oxidative, phototoxic and biological degradation. They are thermally stable within their intended processing temperatures (e.g., 260°C for PTFE). Fluoropolymers have negligible residual monomer, low molecular weight oligomers and leachates in the aquatic environment and soils. A. Biegel-Engler, German Environment Agency - UBA / Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; L. Vierke, German Environment Agency / Chemicals. Perfluorooctanoic acid (PFOA) is a persistent, bioaccumulative and toxic substance. To minimize the exposure of humans and environment a restriction according to REACH will come into force in the EU in 2020. For a global restriction of PFOA alternatives will be considered within the context of the Minamata Convention on Mercury in 2019. However, studies conducted recently in humans indicate that dissolved perfluoroether carboxylic acids in the blood and urine of humans are present at levels that suggest a health risk.

Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoralkyl substance (PFAS) classes, such as perfluoroalkyl 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 Persistent (Pers), Bioaccumulative (Bio), or Toxic (Toxic), or very Persistent (vPvB), or Toxic (vT), or Bioaccumulative (vBio) and can therefore not be considered hazardous under the criteria of the very Persistent and very Bioaccumulative substances that are currently under consideration under the Minamata Convention, and that may be added to Annex 6 of the UN Basel Convention.

**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, Orebro University, Orebro, Sweden

Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoralkyl substance (PFAS) classes, such as perfluoroalkyl 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 Persistent (Pers), Bioaccumulative (Bio), or Toxic (Toxic), or very Persistent (vPvB), or Toxic (vT), or Bioaccumulative (vBio) and can therefore not be considered hazardous under the criteria of the very Persistent and very Bioaccumulative substances that are currently under consideration under the Minamata Convention, and that may be added to Annex 6 of the UN Basel Convention.

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.

**Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (P)**

**TH117**

Challenges and Open Questions in Earthworm Field testing

T. Vollmer, Eurofins Agroscience Services EcoChem GmbH / Field Ecotoxicology; O. Klein, Eurofins Agroscience Services EcoTech GmbH / Ecotox Field; S. Knaebe, EAS Ecotox GmbH / Ecotox Field. In therisk 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 power of 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 composition 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 Carbofuran? 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

L. J. Kamoun, 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 Oekotoxikologie 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 responsible for many soil functions and services. (2) They are also directly distributed in the environment, usually by spraying, but also in various other ways such as a coating on seed 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 comparisons such used for regulation. This data set can be statistically evaluated to develop a model for the study for the earthworm field test. In February 2017, a workshop was held to discuss the outcome of this statistical evaluation and in particular the proposal for a pilot field study test design together with members of the “OECD-GSIE-Earthworm Field Group”. During and after the workshop, the group agreed on a design test including various aspects of statistical robustness, predictability and flexibility. In this discussions various options were checked, all of them with the intention to improve the quality of the output but without increasing the efforts in routine application of the new design. In simulation studies, the number of plot replicates dedicated to either NOEC- or ECx-derivation were varied as well as the number of samples per plot. Additionally, the number of treatments of the chemical to be tested (carbendazim, because it is the reference substance for earthworm field tests for more than 20 years) was also modified in order to cover a broad range. This study can be considered as the biggest earthworm field studies ever conducted. In April 2017, the pilot study was started in a design with 30 plot replicates. After this pre-sampling two further samplings have been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazim on earthworms.

THI120 Soil ecotoxicology research and ecological risk assessment in southern African mining landscapes

M. Mabore, 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 high in heavy metals and therefore extreme care should be given to 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. Key words: soil ecotoxicology, ecological risk assessments, mining, southern Africa

THI121 Establishment of tiered risk assessment approach of pesticides for soil ecosystems 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, regional differences in the organisms (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 high in heavy metals and therefore extreme care should be given to 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. Key words: soil ecotoxicology, ecological risk assessments, mining, southern Africa

THI122 Ecological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks

M. Haen, Kissing, Eurofins-Mitot; S. Aldershoff, Bioresearch and Evaluation; F. Thauvinet, 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 temporal distribution of the application of the pesticides, which is 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**

A. Härgerbäumer, R. Raschke, Bielefeld University / Animal Ecology; S. Hoss, Ecossa / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology

Lower tier testing used for risk assessment of plant protection products (PPPs) is conducted with single species. Informations 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 therefore experiments with 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 Chironomus riparius in sediment (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**

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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 allow for 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 process of OM breakdown, a project on soil functional test systems was initiated by the European Crop Protection Association (ECPA). A field study was set up in 2010, which means a cohort of two depressions (Methamidophos, Lindane) on organic matter degradation in 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 Collombola 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 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 structural endpoints on soil mesofauna (i.e. single species population) 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**

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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 single species model as originally proposed and that they are very much species/context dependent. However, this issue does raise important questions concerning the consideration of both short and long-term, with a potential consideration of potential future population dynamics of 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 whether or how 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 level to allow the development of suitable population models. These models can 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 of the decision making process, perhaps by reducing 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 ECPA non-target arthropod group

**TH126**

**Classification of uncertainty in ecological risk assessment of pesticides**

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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 extensive model results often are not perceived as overcoming the uncertainty, making it, making this an issue of significant concern. The lack of straightforward presentation of all sources of uncertainty puts an extra burden on risk managers. This issue has been recognized by EFSA recently, but still there is very little research into classifying, visualizing and addressing uncertainty in ERA of pesticides. Currently EFSA recognizes standard and non-standard uncertainties in ERA of pesticides. This classification offers little insight into how those two categories impact ERA conclusions and further risk management decisions. In order to address this gap, we have undertaken an appraisal of a large subset of ERAs (102 up to date) conducted for approval of active substances at the EU level. We have been working on ERA data, conclusions on pesticide peer-reviews and Draft Assessment Reports in order to get a picture of the most common types of sources of uncertainty, classify different uncertainties and link them to the risk assessment points of concern, data gaps and risk management decisions. At the moment it is still unclear which sources of uncertainty influence the decision outcome more than others and our preliminary results indicate that it is possible to uncover non-obvious relationships between uncertainty and risk assessment outcomes. It is, for instance, possible to describe how different sources of uncertainty affect the process of ERA (e.g., duration, effectiveness of a Rapporteur Member State in producing a draft assessment report) and compare how uncertainty is addressed in risk assessment for different environmental compartments, especially soil versus ERA for aquatic organisms which is much more developed. We aim to provide a typology of recognized uncertainties in ERA and discuss how it could help inform the establishment of the surrogate reference tier and the subsequent calibration of lower tiers in the new risk assessment scheme for in-soil organisms, which is currently being developed by EFSA. Ultimately, we aim to link the typology of uncertainties in ERA to risk management techniques, in order to help ERA practitioners to better
Derivation of soil threshold concentrations for arsenic: consideration of bioavailability through combination of ecotoxicological and analytical data


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 (1998) are based on total concentrations of the metal ("aquregia"). 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, 0.01M 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 hydrate (Na₂HAsO₄·7H₂O). Chronic toxicity endpoints were tested with microbes, plants and invertebrates, according to ISO standard guidelines, allowing derivation of threshold values via an SSD approach. The results (given as NOEC, EC₅₀ and, preferably, EC₅₀ values) based on the six extraction methods, have been determined. The variation in EC₅₀ 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 < aqua regia for most soils. Plants were the organisms reacting most sensitively, partly together with the Bacteria. Both 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.B. 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 animals 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 through-put of core samples is then used to determine activity of the microarthropods. 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 farm 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. Jänsch, ECT Oekotoxikologie GmbH; P. Nickoll, Federal Agency of Environment / Risk assessment for 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 enable the performance of CPCAT to be assessed with the help of an extensive 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 sounder choice for the determination of earthworm 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 ESG; 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 fumigation, 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 labile substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory activity is then used to determine microbial biomass size. The determination of microbial biomass activity and, via fumigation, 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 labile substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory activity is then used to determine microbial biomass size.
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 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 gauge on the bottom with a small water reservoir beneath it to avoid desiccation. The initial humidity was set to 50 percent 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 at the top, food at 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. Fajana, 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, Opilia 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 enchytraeids 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, stress biomarkers, and bioavailable zinc were determined after 28 days. Habitat quality did not change zinc bioavailability which remained at 2% 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 Parachonorychus kimi (Collembola : Onychiuridae)
J. Wdg, 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 accumulation 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 effects of soil biota 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 Parachonorychus 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?, constant 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 reinhardtii and Chlorococcum infusionum. Eisenia andrei were exposed with 1/4, 1/2 and 1 28 mg/kg of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including tailing, fragments, swelling, bleeding, and mucous secretion were measured. For soil algae, Chlamydomonas reinhardtii 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 exposed. As results, 4-LOEC and 7d-ECSO of MEK to Eisenia andrei were calculated as 1136 mg MEK/kg dry soil and 1910 (1643-2221.58) mg MEK/kg dry soil, respectively. For soil algae, C. infusionum was more sensitive than C. reinhardtii for MEK, 6d-EC50 to C. reinhardtii 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(KEIT) through "The Chemical Accident Prevention Technology Development Project", funded by Korea Ministry of Environment(MOE)(No. 2016001970001). *<strong>Key word: methyl ethyl ketone, earthworm, soil algae

TH136 Effects of endocrine disrupt chemicals (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 chemicals (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 unsusaturated fatty acid (NPUFA). Soil algae, Chlorococcum infusionum was 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 reinhardtii 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 nature and after pH adjustment
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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 andrei (Annelida) 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 this work, enchytraeids and earthworms were exposed to vinasse in nature in occupation 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 biosaiss vinasse compared to exposed to vinasse in natura. The results allow to inquire 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
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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-hexaazaazowurtzitane (CL-20), 2,4-dinitrotoluene (TNT), 1,3,5-trinitrobenzene (TNB), 2,4-dinitrotoluene (2,4-DNT), 2,4-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 defined 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 (low organic matter content very high relative 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. Toxicological 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 Cleanup Values (SCVs). Based on the SSDs and Eco-SSLs 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 derive a specific soil cleanup level (e.g., HC5 or HC50 protection level) that they wish to use to derive a specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH139

Organismal 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 metal-based fungicide applied to fungicidal orchards for fungicidal control, contains 60% copper oxide. In this study, the bacterial strains used (Achromobacter spanius and Bacillus cereus) were previously isolated from gold and gemstone mining sites and confirmed to tolerate copper oxychloride ecotoxicity towards bioremediative traits in metal polluted soils. We examined the effect of indigenous bacterial species were successfully transformed into tolerant and non-transformed E. coli strains and subjected to ecotoxicity tests to determine the metal concentration producing 20 percent decrease (EC20) in the measurement endpoint compared with carrier (acetone) control. Toxicological 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 Cleanup Values (SCVs). Based on the SSDs and Eco-SSLs 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 derive a specific soil cleanup level (e.g., HC5 or HC50 protection level) that they wish to use to derive a specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH141

Characteristics of metal-tolerant bacterial plasmids from a platinum mine tailings dam

T. Mahlatsi, C. Bezuindenhout, M. Maboeta, North-West University / Unit for Environmental Sciences and Management

The presence of mine tailings is recognized to contain high concentrations of heavy metals. Some of these metals are toxic to living organisms, and can persist in the environment for a long time, causing serious environmental problems. Therefore, the development of metal-tolerant microorganisms is an important area of research. The current study was conducted to isolate and characterize metal-tolerant bacterial plasmids from a platinum mine tailings dam. The plasmids were isolated from various heavy metal-resistant bacteria and were further characterized for their metal-tolerant 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 IncQ, IncP-9 and IncW specific primers, where only IncW provided positive results. Minimum inhibition concentrations (MICs) were determined in a microdilution plate assay using various test metals. The isolated plasmids were resistant to various metals, including copper, zinc, and cadmium, and were able to grow in the presence of up to 1000 mg/kg of these metals. The plasmids were also able to tolerate high levels of copper and zinc, indicating their potential for use in bioremediation of metal-polluted soils. The results of this study provide valuable information for the development of metal-tolerant microorganisms that can be used in the treatment of metal-contaminated soils.

TH142

Sensitivity of the waterside species, Yuukianura zeyptekyi (Collemboala: Neanuridae), to cadmium and copper

Y. Lee, Korea University; J. Wee, J. Son, Korea University / Division of Environmental Science and Ecological Engineering; Y. Kim, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

Collemboala 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 Collemboala, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of copper and cadmium of Yuukianura zeyptekyi, known as the species in which they live water, and their biocompatibility was assessed. The results indicated that the species of the proteins were up-regulated while others were down-regulated. The largest numbers of proteins were from 15 – 75 kDa. From the plasmids rendered the E. coli JM109 tolerant to metals, it can be concluded that the change in the protein profiles was due to the effects of the plasmids. Furthermore, that plasmids isolated from various heavy metal-tolerant bacterial species were successfully transformed into E. coli JM109 rendering new metal-tolerant strains. The results indicate that these plasmids could be used as model systems to study the mechanisms of metal resistance and potential bioremediation applications.

TH140

Development of a terrestrial biotic ligand model (TBLM) for predicting acute toxicity of cadmium and zinc to soil collembolan Parazonichirus kimi

J. Son, K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

Collemboala 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 Collemboala, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of copper and cadmium of Yuukianura zeyptekyi, known as the species in which they live water, and their biocompatibility was assessed. The results indicated that the species of the proteins were up-regulated while others were down-regulated. The largest numbers of proteins were from 15 – 75 kDa. From the plasmids rendered the E. coli JM109 tolerant to metals, it can be concluded that the change in the protein profiles was due to the effects of the plasmids. Furthermore, that plasmids isolated from various heavy metal-tolerant bacterial species were successfully transformed into E. coli JM109 rendering new metal-tolerant strains. The results indicate that these plasmids could be used as model systems to study the mechanisms of metal resistance and potential bioremediation applications.

TH143

Drivers of copper and zinc availability and phytoavailability in agricultural soils receiving long-term organic waste amendments

Drivers of copper and zinc availability and phytoavailability in agricultural soils receiving long-term organic waste amendments
the soil parameters such as pH and organic carbon content and reactivity. These soil parameters are both influenced by the application of OW and the toxicological effects of OW are poorly documented when taking into account long-term impacts. Accordingly, we observed a pH gradient as a function of the type of fertilizer (mineral or OW) applied. This research will contribute significantly to the design of risk management measures that will enable us 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.

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 concentrations 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.

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Field Trial to Determine Effects of Thiathionxom treated Sugar Beet Seed on the Non-Target Arthropod Fauna of Arable Field in The Netherlands

C. Eiston, Syngenta Ltd / Product Safety; M. Coulson, Exponent International Limited

The field trial was conducted in March 2017 with the drilling of the sugar beet seed at two different seed treatment levels (0.5 mg/kg), seedling plants (Lactuca sativa), earthworms (Eisenia fetida), SMPE passive sampling filters, Silicon rubber sheets and Chematcher passive sampler. A subset of 10 fluvios was selected based on the DRIFT mid infrared portion using the Kennard-Stone algorithm. These 10 soils are representative of a large fluvios range in terms of their qualitative and quantitative SOM properties (TOC, DOC, HA, FA, WHC, pH, texture, etc.).

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Thiabendazole (TEB) were tested for their effects on the survival of the ground beetle Bembidion lampros. The beetles were collected from agricultural fields either in spring (after overwintering) or autumn (population dominated by newly emerged individuals) and exposed individually to a single pesticide spray applied with the Peterner. In terms of recommended field dose (RFD), Durban appeared almost 10 times more toxic than Sherpa: the 96-h LD₅₀ for Durban was 0.057 (CI 0.048-0.071) and 0.054 (CI 0.046-0.066) RFD for spring and autumn beetles respectively, and for Sherpa ~ 0.556 (CI 0.453-0.704) and 1.003 (CI 0.863-1.214) RFD respectively. However, the toxicity of both insecticides was almost identical for the same soil treatment and conditions, however such studies need to be repeated in order to assess the regulatory acceptable risk of a pesticide to NTAs in-field a study should be designed in a way that enables an adverse effect to be detected if present. A toxic reference is used to show the test design is adequate to demonstrate persistent adverse treatment-related effects. Many of the chemicals historically used as toxic reference items with large historical datasets are now not available due to changing regulations, making it difficult to select a suitable toxic reference. Conducting such a study requires multiple sampling methods such as pitfall traps, mine traps, soil cores and sweep nets to account for different life histories of NTAs species and a team of qualified taxonomists to identify all organisms. In this study NTAs 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 occur. The current EU risk assessment scheme considers that effects on populations are acceptable for the in-field area above the threshold value of 50% if recovery or potential for recovery is demonstrated within 1 year. This study has been designed to enable the assessment of: (1) the magnitude of treatment effects on non-target

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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. Bielski, 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 distribution in the soil after soil saturation with water and 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 Kd 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, Istrea / EABX-CARMA; C.N. Doose, INRS - Centre Eau Terre Environnement; N. Majdi, Ecolab / UMR 5245 CNRS; J. Vedrenne, S. Morin, Istrea Bordeaux / UR EABX; S. Hoß, Ecosa / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology

To assess the lethal effects of 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.constraints with results consistent 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 Kd 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. Quane, Zhan/J. Chowdhury / Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences,  

The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (DEBT) on the springtail Folsomia candidavwere 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 rather than the reproductive capacity of adult springtails. 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 biomagnification 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 epigean 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 available can be considered as representative for soils in Europe. The 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 CEC 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 similarly CEC, corresponding to cEC at the 10th and 90th percentile of CEC 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, M. Markiewicz, University of Bremen / Centre for Environmental Research and Sustainable Technology

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 behaviour 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–hydrogen bond energy was estimated for the quinaldines in the soil. Ecotoxicity was estimated for the quinaldines in the soil bacteria A. globiformis and Collemmbola Folsomia candida in pore-water and soil exposure scenarios. The log Koc values generally increased from an eCEC of 8 to 30 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of CEC 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.

TH162  
Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida

M. Quane, O. Zhang, J. Chowdhury / Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences,  

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of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10 < LC₅₀ < 100 mg L⁻¹ (liquid-only exposure) and 100 < EC₅₀ < 1000 mg kg⁻¹ dw soil (calculated soil-pore water-based) of the quinaldines 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

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Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove 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 of Pb and Zn in the whole plants exposed to the soil amended with soil. As expected, field-collected plants exhibited a large range of Pb 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?


As the soil quality regulation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EFSAs 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 microbial health of the 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 microbial diversity: (i) potential ammonium oxidation activity (PAO) addressing a small, mainly autotrophic bacterial community with comparable low diversity; (ii) respiration activity of the heterotrophic microflora as indicator for the C-transformation with basal respiration activity and activity in the presence of carbon sources (glucose, cellobiose) as well as sulfur or nitrogen containing organic substances (cysteine, alanine); (iii) activity of selected exoenzymes (selection based on the carbon sources used in the second approach). The second and third approach were performed in microwell plates. The three functional approaches (i) PAO, (ii) C-transformation, (iii) exoenzymes seem to be a suitable assessment tool and can provide a benefit in the assessment of chemicals. The combination of results was dependent on the test concentration. The exoenzymes were the most sensitive indicator and seem to be a suitable early warning indicator. An increased concentration of the chemical responsible for the initial effect or a further impact can severely affect the microbial population. Additionally affected nitrifiers indicated a stronger damage. Effects in all three approaches indicated a severe impact. The high sensitivity of the exoenzymes in contrast to the respiration activity of the microbial cells could be due to their location outside the microbial cell and a lower protection level. However, also the small size of the ions as affecting substance has to be considered. In further experiments, the combination of results obtained with the three functional approaches have to be determined with additional chemicals. Due to the use of microwell plates the additional work load seems to be acceptable also for testing in the scope of regulation.

**TH155**

Re-calibration of the earthworm Tier 1 risk assessment of plant protection products - an update

G. Frost, Bayer AG / Ecotoxicology; J. Bendall, Dow Agrosciences; T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsiadis, ADAMA; S. Loutseti, 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

The “harmonisation in tier 1 assessment” of plant protection products (PPP) is expected to increase due to revision of the PECcalc modeling guidance. The new EFSAs guidance foresees to use worst case PECcalc 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 PECcalc 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 PECcalc values based on the new EFSAs 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 set of 5 plant protection products compiled by ECPA companies. In this exercise, the relevant soil layer for PECSoil modeling and assessment factor were adjusted to result in tier 1 protection of unacceptable field study effects. The results of this evaluation give clear evidence that considering a layer of 0-5 cm in combination with the currently used assessment factor of 5 would lead to an appropriate earthworm tier 1 risk assessment (Christl et al. 2016). However, according to EFSA, a more comprehensive risk assessment is required 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.

**TH156**

Digging into the soil risk assessment of pesticides: current approach and its uncertainty

M. Arena, EFSAs - European Food Safety Authority / Pesticides; D. Auteri, s. barbaz, EFSAs - European Food Safety Authority / Pesticides Unit; S. Peiper, German Federal Environment Agency (UBA) / Soil Quality & Sustainability

The current risk assessment for soil organisms, conducted according to SANCO/10329/2002, foresees, at Tier 1, the application of a trigger value of 50%. However, an uncertainty linearity is used in the soil risk assessment of pesticides. However, the lower tier earthworm risk assessment also changed in Europe when the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. As expected, field-collected plants exhibited a large range of Pb 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.

**TH157**

SETAC Soils Interest Group

M.H. Wagelmans, Bioclear earth Protection; A. Sharples, FMC Agricultural Solutions; F. Staab, BASF SE

The current risk assessment of soil organisms, conducted according to SANCO/10329/2002, foresees, at Tier 1, the application of a trigger value of 50%. However, an uncertainty linearity is used in the soil risk assessment of pesticides. However, the lower tier earthworm risk assessment also changed in Europe when the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. As expected, field-collected plants exhibited a large range of Pb 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.

**TH158**

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (P)

SETAC Europe 28th Annual Meeting Abstract Book
TH158
A novel analytical method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives
V. Kisielius, Metropolitan University College; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; M. Rodamer, Agilent Technologies; D. Lindqvist, L.H. Rasmussen, Metropolitan University College

Significant variety of toxic secondary metabolites produced by plants appear in chemical structures of glycosidic molecules. These compounds are highly water soluble and mobile in soils and sediments. In cases when toxic glycosides are persistent and released in high loads from vegetation, evaluation of the risk to aquatic environments and drinking water supplies is needed. Nevertheless, the nontoxic effects of Bracken fern and other toxic plants are largely unknown. This study aims to identify the environmental risk factors that predetermine release of glycosidic natural toxins from non-agricultural lands to aquatic ecosystems. Bracken ferns (Pteridium aquilinum) are known to produce up to 6 kg/ha of carcinogenic ptaquiloside. Previous studies demonstrate leaching of ptaquiloside from Bracken to soils and upper ground waters. The ptaquiloside-like compounds – ptaquiloside, caudatoside and ptesculentoside and their respective pterosin-derivatives (6 compounds in total) can be used for the abovementioned study. The novel LC/MS method (Agilent 1260 Infinity HPLC) is an ultra-performance liquid chromatography combined with mass spectrometry (Agilent 6130 S C18 semi-UPLC column) that detects compounds in the ng/l range. This method can be applied for their removal (Horizon 2020 Research and Innovation Programme NaToxAq, which is funded by the European Union’s Horizon 2020 - CURIE grant agreement No. 722493).

TH159
A novel method for ptaquiloside and pterosin B preservation in groundwater samples
N. Skrbic, University of Copenhagen / Plant and Environmental Sciences; S.C. Christensen, A. Pedersen, HOFOR A/S, Copenhagen; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; L.H. Rasmussen, Metropolitan University College

Analyzing natural toxins in groundwater is challenging due to their labile and volatile, early warning and control of off-odor events. The objective of this study was to develop and optimize an efficient method for monitoring of multi-class HAB odors in freshwaters using automated APP. The study focused on optimization of the SPME factors, including salting out extraction, pre-incubation and extraction times, extraction temperature and stirring rate. 20 model compounds of various chemical classes were chosen for the screening of these two OCs in two drinking water reservoirs in northern Taiwan. In addition, solid phase extraction (SPE) was used for sample cleaning-up and target analytes enrichment. The extracted target toxins were separated on a C18 column with washing of 10% methanolic solution, and then eluting with methanol. The limit of quantitation of MC-LR and MC-YR was 0.06 μg/L, which was below the limits recommended by WHO guidelines for drinking water (i.e., 1 μg/L). A preliminary result revealed that C2–C3 and MC-LR and MC-YR were detected in two reservoirs water samples by using the developed method.

TH161
Matrix-assisted laser desorption/ionization-time of flight mass spectrometry application for rapid screening of microcystins occurrence in northern Taiwan tap-water reservoirs
W. Ding, National Central University / Department of Chemistry

Microcystins (MCs) are the most common hepatotoxins and tumour promoters produced by freshwater cyanobacteria. Despite the damaging the river through inhibition of protein phosphatases 1 and 2A, they pose a serious health threat to humans and animals, and even inducing death. MC-LR and MC-YR are probably the most concern and toxic microcystins. They are also widely distributed and detected in the freshwater system worldwide. In this study, matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF-MS) technique was developed for the rapid screening of these two OCs in two drinking water reservoirs in northern Taiwan. In addition, solid phase extraction (SPE) was used for sample cleaning-up and target analytes enrichment. The extracted target toxins were separated on a C18 column with washing of 10% methanolic solution, and then eluting with methanol. The limit of quantitation of MC-LR and MC-YR was 0.06 μg/L, which was below the limits recommended by WHO guidelines for drinking water (i.e., 1 μg/L). A preliminary result revealed that C2–C3 and MC-LR and MC-YR were detected in two reservoirs water samples by using the developed method.

TH160
Harmful algal bloom smart device application: using image analysis and machine learning techniques for classification of harmful algal blooms
J.M. Lazorchak, U.S. EPA / Office of Research and Development; M. Waters, Northern Kentucky University / Mathematics Statistics; M. Steinitz Kannan, Northern Kentucky University / Biological Sciences Department; H. Mayfield, Foundation for Ohio River Education; J. Allen, U.S. EPA / Office of Research and Development

Northern Kentucky University and the U.S. EPA Office of Research Development in Cincinnati Agency are collaborating to develop a harmful algal bloom detection algorithm that estimates the presence of cyanobacteria in freshwater systems by image analysis. Green and blue-green algae exhibit different Hue-Saturation-Value color histograms in digital photographs. These differences are exploited by machine learning techniques to train a smart device (cellular phone, tablet, or similar) to detect the presence of cyanobacteria in a small surface portion of a freshwater system. The Harmful Algal Bloom Classification Application (HAB APP) has been field tested and verified to classify both green and blue-green algae. Specifically, the APP has been tested on several small streams and ponds, correctly classifying green algae blooms and has been tested on the Ohio River, correctly classifying blue-green algae in the 636-mile cyanobacteria bloom in summer 2015. The application is being tested via fixed camera monitoring stations and optimized at several locations along the Ohio River and in Lake Harsha, a 22,000-acre reservoir which supplies six million gallons per day of drinking water to the Ohio county in which it lies and is a source of many recreational activities, including swimming, boating, and fishing. The presence will be verified by other detection instruments and in vitro by agency scientists and hysteresis techniques will be used to develop water reservoir (i.e., 1 μg/L). A preliminary result revealed that C2–C3 and MC-LR and MC-YR were detected in two reservoirs water samples by using the developed method.
easily computed for classes of compounds. The most significant factor was extraction temperature, especially for volatile early-eluting compounds where fine-tuning of temperature is essential to achieve the required sensitivity. The optimized automated HS-SPME-SC/MS method is proved to be a valuable tool for high-throughput, efficient and sensitive non-targeted screening of HAB odorous compounds, while sensitivity is further enhanced when certain classes of compounds are targeted, e.g. when sensory pre-evaluation of samples is applied.

Acknowledgement

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TH163

Suspected screening of cyanotoxins in freshwater by high performance liquid chromatography coupled to high-resolution mass spectrometry
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Cyanobacteria are one of the components of the aquatic microcystis cession in periphyton formation. The community distribution is affected by water quality, flow regime, climate, and geology. During the past decades, there has been a noticeable increase of 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 cyanobacteria are microcystin (MCs) variants MC-LR, RR, YR, with MC-LR being the most toxic one. For this reasons, 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 robust method of analysis of MCs in high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample pre-treatment of cyanotoxins, solid-phase extraction with multiple toxicants 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 toxicins in the samples. This multi-toxin method has been developed and validated for freshwater cyanobacteria such as microcystins, nodularin, 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.

Acknowledgement

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TH164

Oligonucleotide probes for fluorescence in-situ identification of cyanobacterial cells in surface waters
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Efficient and robust method for the analysis of cyanotoxins in freshwaters based on optimized automated HS-SPME-SC/MS method is proved to be a valuable tool for high-throughput, efficient and sensitive non-targeted screening of HAB odorous compounds, while sensitivity is further enhanced when certain classes of compounds are targeted, e.g. when sensory pre-evaluation of samples is applied.

Acknowledgement

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TH165

Adapty of EPI Suite prediction models to estimate physicochemical properties of natural toxins potentially present in surface water
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Natural toxins constitute a potential risk to water supplies in Europe. Only a few of them can be assessed accurately in water according to the CE regulations. In Europe, the toxic effect of cyanotoxins such as microcystins, neocarzinostatin and anatoxin-a has been extensively studied. Considerable efforts have been made to estimate their 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 interpolation rather than extrapolation, regarding the structure of the chemicals in the training set. 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 water according to their potential risk. The main conclusions are that the EPI Suite models have been tested on pure cultures of Microcystis aeruginosa and Planktothrix agariphila species, that the probes were successfully applied to natural samples collected from surface waters.


TH166

Cyanobacterial oligopeptides of environmental concern and (co)production dynamics
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Our ecosystems and drinking water resources are not only vulnerable towards anthropogenic pollutants. Natural toxins present an additional threat for which we still lack comprehensive understanding and many 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 produced in strategies characterized by indicative nonmonic 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 multifactorial 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 paquidioside under alkaline conditions
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The carcinogenic paquidioside (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus Pteridium (Bracken fern) which constitutes the main contributors of PTA in 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 contamination 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 aeruginosa. PTA (4,700pg) was deglycosylated using 0.10/10/1.0 M NaOH and 3 different 0.025M buffer systems (approx. pH 7-12; NaHPO4/NaHCO3/H3BO3; 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 trace. 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 degradation 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.

TH168
Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins
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The octanol-water partitioning coefficient (Kow) remains one of the key parameters in environmental fate and risk assessment of organic chemicals for regulatory purposes. 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 persist and bioaccumulate in aquatic environments. For compounds such 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 coefficients show limited applicability. Thus, experimentally determined physicochemical property data are still of great value to regulatory organizations defining thresholds for potential environmental contaminants. In this study, Kow values are experimentally evaluated by both indirect and direct approaches based on well-established OECD methods modified for application in natural toxin analysis. A multi-step molecular size and functional group specific calibration procedure is applied in indirect evaluation of natural toxin partition properties based on chromatographic retention. Direct analysis of partitioning behavior is performed in a miniaturized shake flask system in standard HPLC vials. As HPLC based methods, both approaches show the capability to be largely automated for more efficient, less error-prone analysis and thus allow the reliable determination of Kow in the for potential aquatic contaminants relevant range of logKow from -2 to 5. Natural toxins for analysis comprise previously investigated mycotoxins and isoflavonoids as reference compounds in addition to representatives of other compound classes. In regards to predicted toxicity, persistence and mobility as well as plant occurrence, specific natural toxin subclasses such as pyrrolizidine alkaloids from Senecio spp. or quinolizidine alkaloids from Lupinus spp. are investigated in more detail. As an indicator for the partitioning of natural toxins from aqueous media to organic matrices, Kow can be seen as first proxy estimating natural toxin mobility in the aquatic environment. Thus, experimental data will help in prioritizing of toxins for further research applications, including field studies and lab-based characterization of fate processes e.g., within the current MC-ITN NitoXaq, [1] ECECTOC; Technical Report No. 123, 2013 [2] Schenzel, et al.; Environ Sci Technol 2012.

TH169
Phytoxins as aquatic micropollutants: a procedure for prioritization
B.F. Guenthardt, Agroscope / Environmental Analytics; J. Hollender, Eawag / Environmental Chemistry; M. Scheringer, ETH Zurich / Institute for Chemical and Biological Engineering; K. Hungerbuehler, University of Zurich / Institute for Chemical and Biological Engineering; T. Bucheli, Agroscope ART / Environmental Analytics
Phytoxins 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 phytoxins, and systematic and larger monitoring campaigns are completely lacking. A crucial challenge is to systematically identify among the plethora of phytoxins those that actually present a serious risk for the aquatic environment.

For this purpose, we ranked 1586 phytoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytoxins. Toxicity was included as descriptor of the effect and parameterized 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 phytoxins relevant for the aquatic environment we used a procedure, which systematically ranks substances suspected of causing Human gastric cancer. Pterosin B is formed from ptaquiloside 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 ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used to assess previous presence of ptaquiloside. Studies have shown a 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 3.3-7.7). 0.25g of dry soil were equilibrated with 9nl 0.01M CaCl over-night. 1ml of pterosin B solution in 0.01M CaCl was added resulting in a Ceq of 0-10 mg L-1 (n=20). Sorption was 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). Ceq were calculated as CTOTAL - Ceq. Irreversible sorption and microbial degradation was estimated 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 300-2500 mL kg-1. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic matter. As Koc values can vary substantially, depending on soil type and properties, like mineral content and total organic carbon variation were expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of ptaquiloside.

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 ptaquiloside, caudatoside and ptesculentoside (‘the paquidioside group’). Brackens are classified by WHO/IARC 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 ptaquiloside 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 ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used to assess previous presence of ptaquiloside. Studies have shown a 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 3.3-7.7). 0.25g of dry soil were equilibrated with 9nl 0.01M CaCl over-night. 1ml of pterosin B solution in 0.01M CaCl was added resulting in a Ceq of 0-10 mg L-1 (n=20). Sorption was 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). Ceq were calculated as CTOTAL - Ceq. Irreversible sorption and microbial degradation was estimated 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 300-2500 mL kg-1. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic matter. As Koc values can vary substantially, depending on soil type and properties, like mineral content and total organic carbon variation were expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of ptaquiloside.

TH171
Modelling the fate of natural toxins in the soil using DAISY - a case of study for ptaquiloside
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University of Copenhagen
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 loading of natural toxins in the vadose (soil) zone. For this work the model code DAISY, a soil-plant-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 extreme events. This work focused on ptaquiloside (PTA), a hydrophilic and non-sorbing toxin that exhibits a strongly pH and temperature dependent degradation. The carcinogenic toxin is produced by bracken 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. The Maximum 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 were down to the limit of quantitation. Clayey soils presented higher leaching due to macropore transport, as toxins might bypass the biologically active soil layers. Leaching accounts for less than 1% of the total PTA load, being highest in autumn when bracken wilts and the amount of water percolating is highest. The model presents several uncertainties such as the toxin production in the biomass, seasonal variation in toxin concentrations and in particular, the transfer rates from plant to soil. Spraying is not an ideal "dosing" function and might overestimate the leaching, hence the results must be taken with caution.

TH172
Genomic insight into biosynthetic pathway of retinoids by cyanobacteria
L. Sehnal, Masaryk University RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX

Extensive occurrence of cyanobacterial water blooms associated with the production of wide range of toxic compounds into environment represents one of the most worrying problems in aquatic ecosystems. One group of the recently described cyanobacterial toxic compounds are endocrine disruptor compounds retinoids. It has been documented that cyanobacteria are potent producers of retinoids and they are able to produce these compounds into their surrounding environment. However, our understanding how are retinoids synthetized by cyanobacteria on genomic level remains poor and description of the biosynthetic machinery of retinoids is virtually absent. In this contribution we focus on cyanobacterial ALDH and CYP, which are involved in retinoids synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Our study has been inspired by biosynthetic role in their synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Mayor biosynthetic apparatus for retinoids synthesis has already been described. Mayor role in their synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Our study has been inspired by biosynthetic apparatus of retinoids in animals and provides an evolutionary comparison of all ALDH and CYP proteins found 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. Effectivity 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 element in mammalian expression vector. The human 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).

TH173
Emerging treatment methods for the removal of cyanotoxins from drinking water with focus on Advanced Oxidation Processes
M. Schneider, RECETOX, Faculty of Science, Masaryk University / Research centre for toxic compounds in the environment RECETOX; L. Blaha, Masaryk University, Faculty of Science / Research centre for toxic compounds in the environment RECETOX

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, fluctuations 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, 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-)electron oxidation, direct and catalyst-enhanced photolysis, and combinations of these or with hydrogen peroxide. Lesser studied, but still very promising AOPs for the removal of cyanotoxins from drinking water are sonochemical and hydrodynamic cavitation, electrochemical oxidation, radiolysis and other novel approaches such as those based on non-thermal plasmas. The present paper summarizes pros and cons of AOP technologies for the removal of cyanotoxins from drinking water and discusses the post-experimental (and more toxic) forms characterizing the potential and novel AOPs for the removal of less explored cyanobacterial metabolites and their mixtures. Acknowledgement: Supported by NaToxAg (H2020 MSC ETN project agreement No. 722493).

TH174
An overview of the effects and bioaccumulation of ciguatoxins in fish
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Ciguatera Fish Poisoning (CFP), the most common non-bacterial seafood intoxication globally, results from consumption of fish from certain species of dinoflagellates (e.g. Pfiesteria piscicida) and characterized by suit of dominoflagellate derived marine polyether neurotoxins (Figure 1) known as ciguatoxins (CTXs), that target voltage gated sodium (Na⁺) and potassium (K⁺) channels. CTXs enter the food web through consumption of Gambierdiscus spp. dominoflagellates by herbivorous fish. It is well established that the algal CTXs undergo biotransformation in fish organisms (oxidative metabolism) as they pass through the marine food web. Many fish species have developed strategies to detoxify the CTXs. Evidence for concentration of ciguatoxin through the food web has relied largely upon correlation observed between toxicity and trophic level of wild-caught fish. However more detailed regional surveys of multiple species do not uniformly show a clear trend between toxicity and trophic level or size. The absence of signs of intoxication of fish with high CTX concentrations (including fish involved in human poisoning or those tested in the context of field surveys) has long confounded our understanding of how such a potent toxin can be accumulated to the high levels at which it is naturally found (at concentration as high as >10 ng P-CTX-3C equiv. g⁻¹ of flesh). CTXs are suspected to also cause intoxication of fish and marine mammals, however this has never been reported in the field. In this presentation, we will review published and unpublished toxicokinetic and toxicodynamic data of CTX in fish, including CTX bioaccumulation in field fish collected in ciguatera hot spots, CTX specific binding interactions with native NAV, and development of short and long term experimental models of CTX trophic transfer to fish to assess CTX bioaccumulation and effects. Such observations open promising research prospects aiming at the identification of potential ciguatera neurotoxins (e.g. CTX) as a food safety issue. CTXs are bioaccumulated and transferred to marine food web as major contaminant of fish and seafood. Exposure to ecologically relevant doses of CTXs can negatively affect the neurobehavioural status and yield cataract formation in the marine food chain. The impacts of CTXs will be tested in the context of field surveys. Long term exposure can negatively affect the neurobehavioural status and yield cataract formation in the marine food chain. The impacts of CTXs will be tested in the context of field surveys.
B1 (AFB1) 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 AFS 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 demonstrated a contamination of pistachios from Turkish origin with AFB1 and showed that ELISA is a sensitive screening method to monitoring residue levels. The aflatoxin levels in pistachios exceeded even more than five times the maximum permitted limits set by European Commission in Reg 165/2010 and referred to the edible part of the tree nuts. The higher incidence of AFS in imported shelled pistachios is probably due mostly to an easier aflatoxin contamination following the fact that pistachios are harvested in the early stages of maturation relative to the A. flavus colonisation. The paper should be of interest both for readers in the areas of hazard analysis for monitoring purpose, and for other researchers in mycotoxin 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.**

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*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 the comet assay revealed highest damage levels in mussels under combined effects of warming, acidification and biotoxins contamination. The multi- toxin field, due to the great utility of low-cost, rapid and reliable methods of analysis 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 with different freshwater and 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 harms conditions of human exposure.

**TH178**

**Tetrodotoxin an Emerging Threat to Humans in the Mediterranean Area: First Detection in Italian Mussels**

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Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (*Tetrodontidae*) [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 reported so far only in Japan, 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 Siracuse bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophilic 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. Interestingly, 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. Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (*Tetrodontidae*) [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 reported so far only in Japan, 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 Siracuse bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophilic 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. Interestingly, 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.

**TH179**

**Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems**

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**TH179**

**The first report on neurotoxic anatoxin-a occurrence in cyanobacterial blooms in the Czech Republic**

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Prototypal 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 less 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,
and they can degrade drinking water quality, making it unacceptable by consumers. In recreational activities in lakes, they can result in producing T&O compounds, and affected method trueness. The use of the optimized methods, including several extraction/clean up methods, therefore up method, therefore 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 of Dolichospermum sp. were found in all three anatoxin-a positive samples (different species in different samples - D. planctonica, D. smithii and D. flos-aquae). The phytoplankton communities of the anatoxin-a positive blooms were fairly rich in composition containing also Aphanocapsa sp., Aphanizomenon sp., Microcystis sp., Woronichinia sp., Sphaerospormis sp. In addition to CYN and anatoxin-a, the paper discusses concentrations of other above mentioned cyanotoxins and bioactive metabolites and their risks.

TH180
Toxic cyanobacteria succession during a drier summer in a water reservoir in Sicily, Southern Italy. Implications for monitoring programs and risk assessment


Sicily, in the middle of the Mediterranean Sea, is the largest Italian island and is characterized by a dry hot climate. During the forties-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, monitoring programs have been discontinuous, 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 Decree 15 July 2006, completed by a water toxicity assessment through a Vibrio fischeri ecotoxicological test (ISO 11348-3:2007). Lake Disueri (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-Jul and mid-Sept the composition of the cyanobacterial community changed dramatically. In July the bloom was dominated by Microcystis sp. and Cylindrospermopsis raciborskii (in the order of 10⁹ and 10¹⁰ 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-Sept were still growing (10⁸ and 10¹⁰ cell/L, respectively). Disueri Lake is among the largest lakes, with a surface of 1,850 km² and a maximum depth of 31 and 15.2 m, according to specified procedures. Samples of cyanobacteria cultures (50 strains) 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 Cylindrospermopsis (CYN), Anatoxin-a (ANA-a) and Microcystins (MCs), in freshwater fish tissues. For the efficient extraction of selected cyanotoxins from fish tissue (muscle and liver), prior to LC-MSMS analysis, several combinations of extraction solvents at different pH were tested. Additionally, various treatment techniques, i.e. protein precipitation using addition of salts and hexane extraction of lipids, were also tested in order to eliminate matrix effects. The maximum preconcentration of the compounds and in order to further eliminate matrix interferences. The effect of matrix components was evaluated by comparing LC-DAD and LC-MSMS chromatograms under identical chromatographic conditions. Finally two extraction/clean-up methods were developed, i.e. one for the maximum recovery of selected MCs and one for CYN and ANA-a, offering maximum recoveries for the selected toxins. The developed methods were applied on fish samples, collected from Greek Lakes. The optimized method for MCs provided maximum recoveries 87% and 81%, for MC-RR and MC-LR, respectively. These compounds did not co-elute with several matrix components after the selected pretreatment/clean-up method, therefore 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 blooms, 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.

TH181
Cyanobacteria taste and odor compounds; a study in freshwaters of Greece

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TH182
Determination of multi-class cyanotoxins in fish tissues
C. Christophoridis, National Center for Scientific Research / Institute of Nanoscience and Nanotechnology; I. Argyropoulos, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL; T.M. Triantis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; A. Hiskia, National Center for Scientific Research (LIAA), Dip. G.F. Ingrassia; E. Testai, Istituto Superiore di Sanita’ / Dip. di Ambiente e Salute

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TH183
Effects of Asparagopsis armata extract on the fatty acid profile of two marine invertebrates
C.O. Silva, Polytechnic Institute of Leiria; T.F. Simes, S.O. Novaia, Polytechnic Institute of Leiria / MARE IPEleiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPEleiria

Invasive alien species represent a worldwide threat to the integrity of native communities, which include natural as well as global changes in lower trophic levels. It has been shown that the red seaweed Asparagopsis armata exerts a strong invasive behavior and it is included in the list of the “Worst invasive alien species threatening biodiversity in Europe”. This alga has been shown to produce a large diversity of halogenated volatile organic compounds with potent biological effects. It can be found on tide pools during the low tide, where its exudate released can present concerns as chemical pollutants do, and are thus often referred to as biocidal pollutants. The red seaweed Asparagopsis armata exerts a strong invasive behavior and it is included in the list of the “Worst invasive alien species threatening biodiversity in Europe”. This alga has been shown to produce a large diversity of halogenated volatile organic compounds with potent biological effects. It can be found on tide pools during the low tide, where its exudate released can represent a threat to the organisms present in just a few hours, leading to a reduction in abundance of native species. Marine organisms, in particular invertebrates, have proven to be a major source of unique fatty acids (FAs). Membrane lipids,
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-webs (Silva et al. 2017). In this study, the potential impact of A. armata exudates in the FA profile of two marine invertebrates was assessed. For this, after calculating the lethal concentrations of the algae exudate, Gibbula umbilicalis and Palaeon 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 shrimp hepatopancreas. Results showed different FA profiles between invertebrates but for both 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 macroalgae toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

TH184 Impacts of Asparagopsis 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 IPLeiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

The introduction of non-native seaweeds outside their native distribution range, through human activities, has been causing documented negative effect on native species. The red algae Asparagopsis 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 enclosed and extreme conditions are often adverse for other species such as other seaweeds, 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 macroalga. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20°C±1. After exposing the macroalga, the exudates released to the environment and can serve as warning indicators of compounds in the Environment. Results showed different FA profiles between invertebrates but for both species the profile was influenced by exposure to the exudate concentration of the algae exudate, animals were exposed for 168 hours to non-lethal concentrations of this exudate and subsequently analyzed for biomarker biochemical responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalse, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AChE) and energy metabolism (lactate dehydrogenase, LDH; Isocitratdehydrogenase, 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 Asparagopsis armata 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 macroalga on the invaded ecosystems under a global change scenario.

TH185 Assessing consumption risks through cadmium-contaminated shellfish amplified by ocean acidification
W. Chen, Kasetsart University / Dept Biomedical 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 in order to project physical 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. Kuběčková, 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. Baba, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX

Amphibian pulmonary epithelium is sensitive to changes in ocean chemistry. In this study, we investigated effects of cyanotoxin inhalation on respiratory cells. We exposed HBE1 and 16HBE14o- cells to the cyanobacterial toxin of emerging concern, CYN, a toxic metabolite of the cyanobacterium Microcystis aeruginosa. We exposed the cells to different concentrations of CYN and assessed the potential for deleterious effects. To assess inhalation toxicity, we measured changes in cell viability, cytotoxic effects and the production of pro-inflammatory cytokines. To assess respiratory effects, we evaluated changes in the expression of genes involved in cell survival, inflammation, and oxidative stress. Our results showed that exposure to CYN induced cytotoxic effects, increased inflammatory cytokine production, and altered the expression of genes involved in cell survival and inflammation. These findings highlight the potential risks associated with exposure to cyanobacterial toxins in respiratory cells. Further research is needed to better understand the mechanisms underlying these effects and to develop strategies to mitigate their impact on human health.

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. Kuběčková, 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. Baba, 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. However, MCLR has been shown to induce a number of other deleterious effects on human cells, including cytotoxicity and induction of inflammation. In this study, we investigated the effects of MCLR on human bronchial epithelial cells (HBE1). HBE1 cells were exposed to different concentrations of MCLR and evaluated for cytotoxicity, inflammation, and changes in gene expression. Our results showed that exposure to MCLR induced cytotoxic effects and increased the expression of pro-inflammatory cytokines. These findings highlight the potential risks associated with exposure to cyanobacterial toxins in respiratory cells. Further research is needed to better understand the mechanisms underlying these effects and to develop strategies to mitigate their impact on human health.

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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 cellular 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 on long-term effects of MCLR and LPS on inflammation-related endpoints. Inhalation toxicity of other hard-to-reach cyanobacterial toxins 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 NeToxAq.

TH188

Estrogenic and retinoid-like activity in stagnant waters
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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 cyanotoxin metabolites could include compounds with estrogentic and/or retinoid-like activity. Endocrine disruptive compounds can 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 morphogenesis, 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 ngEQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic hormones, 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 retinoic substances, where 4-keto all trans retinoic acid and retinal were the most common forms detected in the samples. Retinoid-like activity was almost fully explained based on concentration and retinoid-like activity of individual for each retinoids. However, results also suggest that still other compounds with retinoidic receptor-mediated modes of action are present. Our study highlights the ability of common species of cyanobacteria to produce retinoids naturally and excrete them directly into the environment in concentrations that can reach hazardous level for vertebrates 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
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Diaminobutyric acid (DABA), a non protein amino acid, was first shown after isolation from Lathyrus and related seeds, but mechanisms of neurotoxicity were never completely explained. DABA is also produced by Cyanobacteria in aquatic and terrestrial ecosystems. In the light of scarcity of electrophysiological studies and ubiquitous presence of DABA-producing Cyanobacteria a standardized inhibition effect on membrane potential of Retzius leech neurons. Experiments were conducted on Retzius nerve cells of isolated segmental ganglia of the leech H. sanguisuga. Classical intracellular recording technique was performed. Cell membrane potentials were recorded using glass single-barrel microelectrodes and amplified with a high input impedance amplifier. DABA was administered in concentrations of 1, 3, 5 and 10 mM over a period of three minutes each. Input membrane resistance was investigated using current clamp technique by injecting hyperpolarizing current pulses through the recording electrode via a Wheatstone bridge unit. Application of 1mM DABA solution depolarized membrane potential by 5.0±0.43 mV (n=6, p<0.01), while 3 mM DABA produced depolarization of 9.8±4.1 mV (n=7, p<0.01), Rapid and substantial depolarization of membrane potential by 39.6±2.2 mV (n=9, p<0.01) was induced by 5 mM DABA, and administration of 10 mM DABA caused membrane depolarization of 47.05±2.3 mV (n=6, p<0.01). DABA had several times higher efficacy than Glutamate and JN-N-methylmethyl-L-alanine (BMAA) on our model. After washout, cells exposed to 1 or 3 mM DABA fully recovered, but on the cells treated with 5 or 10 mM DABA no recovery was observed. Application of 10 mM DABA there induced a decrease of the input membrane resistance by 8.09±1.51 MΩ (n=7, p<0.01). DABA elicits substantial dose-dependent membrane depolarization. Decrease of input membrane resistance indicates that this effect is a consequence of increased membrane permeability. At higher concentrations DABA induces irreversible functional changes of neurons, confirming neurotoxic effect. As DABA is often produced together with BMAA and other cyanotoxins, some of their previously attributed neurotoxicity could possibly be due to effects of DABA and/or their synergy. Keywords: 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

TH190

Generating ecotoxicity information on microcystins and pyrrolemins: A different approach

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 microcystin-LR range from ~21 mg/L. There is even less ecotoxicity information available for pyrrolemin which is produced from the estuarine algae Pryninsirum 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 phyltoplankton samples collected from hydroelectric/dinking water reservoirs in Brazil. They found that reservoir samples with higher microcystin contents were the most toxic ones and that different cladoceran species 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 flos-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 1:80 dilution. Flos-aquae cells were lyophilized. Forty-eight hour acute tests were conducted with Ceriodaphnia dubia, Hyallela azteca larval Pimephales promelas and Neocloeon triangulifer 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 flos-aquae caused significant mortality to N triangulifer 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.
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 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 thioredoxin, 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

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### TH192

**Probabilistic human health risk assessment for dietary exposure to aflatoxin in Taiwan**

MT. Ling, Y. Wang, National Taiwan Ocean University; K. Lien, National Taiwan University

Aflatoxins (AFs) are secondary metabolites naturally occurring in many different kind of food, including peanuts, spices, rice, tree nuts and maize. As both genotoxic and carcinogenic substance, aflatoxins could cause severe adverse health effect. AFs have been classified as group 1 carcinogen by International Agency for Research on Cancer (IARC), because of sufficient evidence provided by cancer studies in humans and experimental animals. The purpose of this study is to evaluate the probabilistic risk of people in Taiwan who accidentally consuming aflatoxin contaminated peanut and peanut products. Concentration data of AFs (1.84 ± 4.03 ppb) are gathered from Taiwan Food and Drug Administration (TFDA) between 2005 and 2015, along with consumption rate data (from Nutrition and Health Survey in Taiwan (NHSTP) and NHSTPII) of 1-2 baby, 3-9 toddler, 10-17 teenager, 18-65 adult and above 65 elder) in two sub-populations (whole group and consumer only) are essential parameters for exposure analysis. Based on benchmark dose lower confidence limit 10% (BMDL10) (170 ng/kg bw/day) suggested by European Food Safety Authority (EFSA), calculated Margin of Exposure (MOE) value is below 10,000. As the result, it isn’t fit the recommended standard by EFSA.

According to cancer potency from Joint FAO/WHO Expert Committee on Food Additives (JECFA), estimated population risk ranged from 0.0007 to 0.2713 cancers per 100,000 population per year. This study has calculated the risk of total aflatoxins contaminated peanut and peanut products by MOE approach and population risk method. From the result of population risk for primary liver cancer (Hepatocellular Carcinoma, HCC), it is obvious that aflatoxin isn’t the major cause of HCC. Despite the low cancer risk, MOE calculation indicates a possible health problem for Taiwan population. Further studies could focus on the prevention and reduction of AFs in order to reduce AFs occurrence in foodstuff, especially reducing risk for high exposure and vulnerable groups.

### TH193

**Organ distribution of the environmental neurotoxin β-N-Methylamino-L-alanine in the freshwater mussel Dreissena polymorpha**

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Among toxins of planktonic origin, β- N-Methylamino-L-alanine (β-N-Methylamino-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 could 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 a variety of foodstuffs. In this study, 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, and is widely distributed in the water column, and therefore could be in contact with BMAA in-situ. This freshwater mussel has already been used in bioaccumulation studies in order to detect heavy metals, pesticides as well as parasites and could potentially be used to biomonitor BMAA. It has already been shown that Dreissena polymorpha could bioaccumulate BMAA, but further information is needed to understand how this toxin is distributed in individuals. The study of BMAA has long been an analytical challenge: diverse extractions methods are available in order to study this hydrophilic compound. Through the use of polar solvents like trichloro acetic acid (TCA), it is possible to determine the “free BMAA” fraction and a hydrolysis of the whole sample will inform about the “total BMAA”. As it was discovered that after a hydrolysis step, more BMAA could be released compared to untreated sample, a hydrolysis of the precipitate obtained during extraction will informed about the “precipitated bound fraction” and an hydrolysis of the supernatant will informed about the “soluble bound BMAA”. Here, through and exposure of zebra mussels to 2.5 µg of dissolved BMAA/individual/day, for 21 days followed by 21 days of depuration, we studied the organ distribution of the BMAA among: hemolymph, gills, digestive gland, gonad, mantle, foot and muscles. Results will be discussed in terms of the distribution of various fraction (i.e., total, free, soluble-bound and precipitated-bound) according to the organs.

### TH194

**Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dendrobena veneta (Annelida)**

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The aim of this work was to study the effects of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) on invertebrates living in contaminated sediments. Dendrobena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (lymphytosis and lyosomal 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 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 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 with both the short and the long-time exposures. In the soft tissues primary data don’t show a significant difference 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 PFASs seem 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. In our results show, for this invertebrate organism, a higher PFBS bioaccumulation than PFOA and significant exposure effects to the two PFASs 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.
TH196 Interpretation of bioassay results in the context of the soil quality TRIAD approach.
N. Pandur, 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 area taxed to about 100 years ago. To this end, one bioassay identified as “4'-OH-2,2',4'-tetrabromo-DiPhOBz.” Chemically related methoxylated tetra bromo- to hexabromobenzene (HBBz) 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 (PBB) compounds. The present study investigated the potential thyroid hormonome of 2,2',4'-tetrabromo-DiPhOBz. Three strains of S. oryzae— and hydroxy analogues, using an in vitro competitive protein binding assay binding with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). 

TH197 Estimating the hazardous concentrations of nonylphenol for soil ecosystem protection with protein approach
I. Kaku, J. Moon, 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, caryophyllales, lamiaceae, solanaceae, and coniferales) 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 HC1, HC10, HC50 and HC90 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) as the Environmental Health Action Program (148501458)

TH198 Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transhretin In Vitro
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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 organophosphate triesters that are currently known about the biological effects of these polybrominated (PB) triesters-based compounds. The present study investigated the potential thyroid hormonome of 2,2',4'-tetrabromo-DiPhOBz. Three strains of S. oryzae— and hydroxy analogues, using an in vitro competitive protein binding assay binding with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). Para-0H-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 in silico than competitive in silico studies. Based on the results of these investigations, there is potential for these exogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.

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 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 referring phosphine 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, 7.31 and 23.74 μM 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, jhp, voltage, casp, wnt7, wnt11 were analyzed using RT-PCR for comparing gene expression and cat gene was dramatically down-regulated in the R strain. Jhp gene expressing juvenile hormone inducible protein was differentially expressed in the two phosphine-resistant strains, which was also up-regulated in medium resistant strain, but it was not so big difference. 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 jhp 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. Baik, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe; Y. Kang, KIST Europe / Environment and Technology / Biology; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division
Tetradeabromo-1,4-diphenyloxenylene (TeDB-DiPhOBz) is a highly brominated additive flame retardant (FR). Debrominated 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 tetra bromo- to hexabromobenzene (HBBz) 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 (PBB) compounds. The present study investigated the potential thyroid hormonome of 2,2’,4’-tetrabromo-DiPhOBz. Three strains of S. oryzae— and hydroxy analogues, using an in vitro competitive protein binding assay binding with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). Para-0H-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 in silico than competitive in silico studies. Based on the results of these investigations, there is potential for these exogenous chemicals to interact and possibly influence vertebrate thyroid hormone-dependent function.
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 detection sensitivity was also observed (ZFL) to investigate recoveries 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 ZFL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZFL exposed to different concentrations of a target chemical as well as 6 mg/L of H₂O₂, a negative control. The lowest concentration of GSSG in this work was 5.0 mg/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
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A wide variety of contaminants and pollutants 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 consumed 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 geographic position of the sampling sites, a 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 bivalve types of high commercial interest such as mussel, oyster and cockle. 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.

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TH203
River ecosystem: an ecosystem approach to evaluate the ecological risk linked to the human health protection
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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 adopted 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 PVII; 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 jejuni; vial inoculation and microbiological analysis is performed in triplicate), HAV and HEV, Norovirus NoGi and NoGiII, Reovirus, Enteroviruses: A, B and C, Adenoviruses: 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 aspect is 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 original 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.
RESULTS: We found that PNECs for inhibition of lysosomal membrane stability and phagocytic 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 MPs. 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 (unknown) 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 POCl3 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 noted 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 Vooigt, University of Amsterdam / IBED; P. Verdonck, University of Amsterdam / Department of Freshwater and Marine Ecology

The European Union Water Framework Directive requires member states to assess chemical surface water quality 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 chemicals that have serious impacts on water quality. 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 involved bioassays using passive sampler extracts (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 daphnids 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 (an attributional acute in-vitro estrogenic activity; 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 - explanatory bioassays to detect chemical compounds J. Novak, Masaryk University / RECETOX; Z. Tousova, B. Vrana, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; F. Smedes, RECETOX / Environmental chemistry and modelling; R. Grubic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydroinvertebrates; S. Ali-Aissa, INERIS / UMR BEJOCOT; M. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; K. Hilserova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment

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 SAMU device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar compounds (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 the literature (POCIS) or calculated from the ratio of the concentration in the samplers to the concentration in the water. Both the samplers 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 (BEQαm) of respective model compounds in water. The BEQαm 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 (BEQαm). The bioanalytical equivalents (BEQαm) for the detected chemicals explained mostly a low fraction of the BEQαm. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQαm was comparable with the BEQαm levels. Both sampler combinations proved to be suitable for the detection of a large set of chemicals even at trace levels and for the complementary 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 M. Verdonck, Ghent University / Centre for Environmental Toxicology and Aquatic Ecology; J. Koch, GhEnToxLab (Ghent University) / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University / UGent; S. Ait Aissa, INERIS / UMRI  SEBIO ECOT; M. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; K. Hilserova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment

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 bioassays 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 innovative samplers (e.g. Speedisks™) an extraction is needed before spheronisation 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 for testing environmentally realistic chemical contaminant mixtures in terms of qualitative chemical composition. In the current study we extracted Speedisks™ 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 procedures: a sequential and a parallel extraction approach using three solvents: acetone, ethyl acetate and dichlormethane. We exposed 80 larvae diluted into 8 replicates in a fully randomized setup including controls and solvent controls to each of the Speedisks™ extracts and counted larvae and copepodites after 466 SETAC Europe 28th Annual Meeting Abstract Book
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 Speedisk™ extracts and we expect no direct effects of environmentally realistic contaminant mixtures on the development of *N. spinescens*.

TH211 Passive dosing of polar and non-polar substances using Oasis HLB® - Pre-equilibration of media for transferring complex mixtures

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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 to hydrophobic contaminants, but also a significant adsorption of charged substances. This could also be shown, that 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 passive 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 of 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 breath samples mixed 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

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The ability to generate a true solution of a chemical substance at controlled concentrations is essential to generate meaningful aquatic toxicity information. This is especially true for testing complex environmental mixtures, and becomes highly challenging when dealing with hydrophobic (logK<sub>OW</sub> > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but also human health. Previous studies have reported a strong presence of pharmaceuticals from contaminated sites using genetically modified bioassays for agonistic and antagonistic effects. Therefore, a target screening will be used consisting of respectively bioassays and in vitro test systems. Particularly, 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 vitro* and *in vivo* test systems, and becomes highly challenging when dealing with hydrophobic (logK<sub>OW</sub> > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but also human health. Previous studies have reported a strong presence of contaminant 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

TH213 Identification of Gestagen(s) and Corticosteroid(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach

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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 this study is to identify compounds responsible for gestagenic and corticosteroid 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 (LVSPE) and was pre-screened on genetically modified bioassays for agonistic and antagonistic interactions in vitro. The extracted fraction was fractionated using reversed phase high performance liquid chromatography (RP-HPLC) by using C-18 silica based column. One 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 active fraction by using aninopropyl) column with gradient elution with methanol/water (30:70) 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

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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 EnForce project that aims to investigate the toxic responses of mixtures of pollutants and integrate those results into risk assessment. Particularly, perfluorinated compounds 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 vitro* and *in vivo* test systems, and becomes highly challenging when dealing with hydrophobic (logK<sub>OW</sub> > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but also human health. Previous studies have reported a strong presence of contaminant 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

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)

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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

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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 (DOE 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary, 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 lyticea yeast screen. Further evaluation of the data and investigation on genotoxicity using the Ames assay is needed to make a well-founded decision on which assays, 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 riverine ecotoxicological 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

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The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluated pesticides in sediments and in catchments dominated by intensive 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 RQmix 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 mixture assessment. A second test on a sediment sample from the Musi River indicated that biodegradation had not occurred.

TH218 An ecotoxicological assessment of Lake Mondsee, Austria: a two year survey

S. Gonzalves, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; C. Venâncio, Department of Biology / Biology; S. Loureiro, Universidade de Aveiro / Biology; R. Vogt, J. Wanzenböck, University of Innsbruck / Research Institute for Limnology Mondsee, 5310 Eschelisbach. In this study, the biological investigations proved to be a valuable link between the chemical compound risk assessment and stream biology.

TH217 NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments

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NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments. Agriculture is considered as the main source of pollutants in Swiss streams. Therefore, the monitoring of agricultural streams is of high importance. The research project “ecotoxicological risks in small agricultural Swiss streams in the year 2015” (NAWA SPEZ 2015) was established to monitor the ecotoxicological risk for aquatic biota of five small Swiss streams with agricultural catchments. In total, 14 study sites were selected and five sites were permanently monitored over the whole year. Four sites were sampled monthly, whereas one site was sampled every 3 months. The study was conducted from March 2015 to February 2016. The ecotoxicological risk assessment was based on the Freshwater Ecotoxicological Risk Assessment System (FERTAS) of the Federal Office for the Environment (FOEN). FERTAS provides an ecotoxicological risk assessment for aquatic biota in Switzerland. In the present study, the ecotoxicological assessment was focused on gamic and larval stages of Gammarus due to their strong impact on food webs. For the risk assessment the acute toxicity test with Gammarus pulex (EC10: 0.3 mg L−1) was selected. The conducted risk assessment showed that agricultural streams are exposed to a high ecotoxicological risk. This underlines the importance of the monitoring of agricultural streams in Switzerland.
TH220 Mutagenic and ontogenetic responses in freshwater guppy Poecilia vivipara chronically exposed to waterborne sodium dodecyl sulfate (SDS)
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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. This study evaluated the mutagenic and ontogenetic effects of SDS in guppies, Poecilia vivipara, chronically exposed to this chemical at different concentrations. Male and female guppies were exposed to SDS levels of 0.3 mg/L (low), 0.6 mg/L (medium), and 1 mg/L (high) for 90 days. After exposure, the guppies were killed and their morphology and karyotype were studied. The results showed that SDS at all concentrations caused morphological abnormalities, including an increase in the frequency of micronuclei (MN), which is indicative of the presence of genotoxic pollutants in the environment. The study highlights the importance of monitoring aquatic environments for the presence of such chemicals, which can have significant ecological impacts.

TH222 Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment
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Commercial objects made of plastics are composed of two different compounds with distinct ecotoxicological properties, namely the polymer matrix and the chemical additives used to provide the physical and chemical properties demanded by the consumers. Most conventional plastics are made of innocuous monomers (olefins, terphenylates), they are inert under environmental conditions and, according to standard ecotoxicological bioassays using early life stages (ELS), do not pose a significant ecotoxicological risk to marine organisms, with the possible exception of mechanical damage. In contrast, many common plasticizers (e.g. orthophthalates), flame retardants (polybrominated and organophosphorus chemicals), UV filters (benzophenones and other aromatics) and biocides (triclosan) have shown sublethal toxicity for the reproductive and endocrine systems of aquatic organisms. Those potential effects are difficult to test in laboratory since they may involve long exposure times and plastic-organism interactions not considered in standard toxicity tests. Using ELS of marine organisms, we have adapted standard bioassays with ELS, tested ‘virgin’ microparticles of conventional polymers (PE, PS, PVC) and did not find any relevant short-term toxicity. In contrast, when microparticles obtained from commercial plastic objects are used events of acute toxicity are found, pointing at the additives as the causal agents of the toxicity found. Ongoing experiments explore the kinetics of additive leaching and resulting toxicity in order to assess the relevance of the results under environmental conditions. In addition, some commercially used chemical additives of plastics were also tested and some of them did show acute toxicity at levels not far above those found in polluted coastal waters. The overall experimental evidence obtained so far using standard bioassays with ELS of marine invertebrates point at certain chemical additives as ecotoxicologically unacceptable and stresses the need of finding non-toxic alternatives useful for the industry.
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, estrene) and synthetic (nonylphenol, bisphenol-A) compounds presenting inhibition or mimicking of the reproductive action of endocrine system in both men and humans. Recently, several studies reported that daphnids, species which reproduce by parthenogenesis may develop male offspring 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 study 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 a insight into the endocrine disrupting effects of EDCs on aquatic organisms under influence of thermal effluents discharged into streams and rivers.

TH225
Microplat Alga Growth-Inhibition Bioassay
J. Ituria, O. Jaka, C. Martí, A. Alzuále, BioBide; A. Muriana, BBD BioPhenix S.L. / RD
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 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 alga 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 read produces 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 SLEEPBALANCE®
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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 SLEEPBALANCE® 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 study Responsible Research and Innovation in Industry
E. Yaghmairi, I. Van de Poel, Delft University of Technology / Values, Technology & Innovation; A. Porcari, Aiti - Italian Association for Industrial Research; E. Mantovani, E. Bossera, 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.rrri-prisma.eu), we overcome these current limitations by carrying out eight RRI pilot projects in a real-world industry context. To establish the added value of the RRI approach and its 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
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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’Oreal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutrality 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 Diana Indrane on “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 the social pillar can be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study
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Abstract Along with environmental and economic assessment, social sustainability of the bioeconomy have become a growing challenge, with important effects on 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 and of the 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 - in clean / circular economy}
Concerning the oil extraction activities into the sea

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The welfare of workers requires attention on these points to get closer to the improve security conditions in the facilities in order to reduce the risks to health. This approach allows to determine specific supply chains required for the production and delivery of heat (in all sectors), electricity and mobility services. Foreground LCI data for the capital equipment (primarily plant and vehicles) and fuels are taken from output data from energy systems models. Background LCI data about separate future energy technologies (as represented by the identified foreground processes noted earlier) start from existing LCI data for current systems (from Ecoinvent) to which changes are made based on certain assumptions about future developments of the technology in question. Thanks to the availability of price data for material in the latest version of Ecoinvent, LCI data acquired can be converted into monetary values. Finally, the cost data can be inputted into a multi-region IO-table linked worker hours model such as social hotspots database. This yields the country specific sectors required for the material in the energy system. The social impacts are then be evaluated with social theme tables for each country specific sector. It is proposed that IO-tables used should be adapted in order to reflect the development of the energy system in the future. Since the energy models and scenarios used in REFLEX are preserving in nature, it is suggested as a simplification that social impacts for the future system must be quantified for the characteristics used as a base for the evaluation and application of tools across industry sectors, regulatory agencies and international boundaries. Authors: Serenella 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 Maria Antonietta Orri – National Institute of Health - National Center for Chemical Substances Debora Romoli - Italian National Institute for Environmental Protection and Research.

TH233
Multidisciplinary approach for discussing the rice crop specific needs in Southern Europe in the view of the Plant Protection Products assessment: conclusions from an ad hoc workshop

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TH234
The Water Column Monitoring Program in Norway: when regulation and science meet

D. Pampanin, International Research Institute of Stavanger; S. J. Brooks, NIVA (modelled techno-economically as part the Horizon 2020 project REFLEX). It has been developed in light of previously published work aiming at life-cycle based social and/or environmental assessment of single energy technologies and energy systems with a future perspective, and in careful collaboration with the handbook of REFLEX partners responsible for energy systems models. The functional unit for the assessment of the future scenarios is the provision of energy services in the EU in 2050 (the final year of the scenario and modelling). The system boundary for the energy system includes all energy flows and associated supply chains required for the production and delivery of heat (in all sectors), electricity and mobility services. Foreground LCI data for the capital equipment (primarily plant and vehicles) and fuels are taken from output data from energy systems models. Background LCI data about separate future energy technologies (as represented by the identified foreground processes noted earlier) start from existing LCI data for current systems (from Ecoinvent) to which changes are made based on certain assumptions about future developments of the technology in question. Thanks to the availability of price data for material in the latest version of Ecoinvent, LCI data acquired can be converted into monetary values. Finally, the cost data can be inputted into a multi-region IO-table linked worker hours model such as social hotspots database. This yields the country specific sectors required for the material in the energy system. The social impacts are then evaluated with social theme tables for each country specific sector. It is proposed that IO-tables used should be adapted in order to reflect the development of the energy system in the future. Since the energy models and scenarios used in REFLEX are preserving in nature, it is suggested as a simplification that social impacts for the future system must be quantified for the characteristics used as a base for the evaluation and application of tools across industry sectors, regulatory agencies and international boundaries.
Norwegian Institute for Water Research; B. Grovik, Institute of Marine Research; E. Lyng, International Research Institute of Stavanger; R.C. Sundt, 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 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 2010, new guidelines were released 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 North Sea and Egersundbanken (reference area) and in addition the near platform effect (Stařídk 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 impacts. The immediate action cutback were measure to the degree of uncertainty in both exposure and ecotoxicological higher tier effects 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.

The case study also demonstrates the combined applicability of experimental data, Q SAR 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 Injury 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—federal contaminations performed since 1995. The guidance document of ecological risk assessment (ERA) as a site management tool, a Focus Group developed guiding 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 CADESS guidance, though it is simplified in an early, context-specific use for conducting an environmental 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 systematic 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 MV+V. 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.

TH238 Improving “man via the environment” exposure assessment for lead: a case study on fish with lead and related recycling uses
S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; F. Verdonck, ARCHE; K. De Brouwere, VITO NV / Health; L. Geerts, VITO NV; J. Chowdhury, International Lead Association / Senior Scientist -Environment; L. Allen, S. Binks, International Lead Association
Current chemical safety assessments for metals under REACH typically include a generic, worst-case approach of lead with a focus on occupational exposure for lead 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 USEtox and Expo 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 MV+V. 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, J. 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 affecting the 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 wastewater stream of this specific STP were gathered and compared to the calculated elimination. The biodegradation 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 show far 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 a two-fold higher elimination rates which reflect 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.

TH240

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. Kodek, Czech Hydrometeorological Institute / Section of water quality; L. Brodsky, Mapraxis Ltd.; T. Herza, Hydrosoft Veleslavín 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 available coarse statistical data. The pesticide load was calculated as a sum of loads of contained in EEA and LDCM data. It was possible to calculate pesticide loads at a spatial resolution of 1x1 km grid step. Maps were shown for Czech Republic in the cropland monitoring and for cropland areas with more detailed data (on cropland with pasture, urban and leisure areas) ut the present of agricultural plantations.

TH241

A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.

A. Rataj, Istreza Lyon; C. Lopes, Universitè Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, Universite de Bordeaux; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; L. Delorme, L. Garnero, Istreza Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Istreza / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Istreza / Water

Toxicokinetic models are used to describe how organisms bioaccumulate chemicals or other substances according to uptake and elimination processes. They provide a theoretical framework for understanding phenomena, testing hypotheses, and predicting some outputs of interest. In these models, the absorption process can result from dissolved or trophic routes. The elimination process includes excretion, biotransformation and dilution by growth. To date, models exist to describe the accumulation of persistent chemicals (invertebrate second order kinetics) in various aquatic organisms. However, taking into account biotransformation remains problematic despite its potential importance. It is a key process that can limit the bioaccumulation of parent compounds while generating potentially hazardous metabolites. It varies considerably among species and contaminants. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model taking into account biotransformation, by considering the multimedia model Simple Treat 3.1, 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 a two-fold higher elimination rates which reflect 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.
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 was observed in 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 repellant 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 that 75% of all the e-waste generated globally is exported to developing nations. For developing countries, the management of e-waste is complicated by illegal waste shipments and further exacerbated by weak environmental regulations and resource constraints in high-income countries such as Canada. Here, we have undertaken the first study to report on concentrations of flame retardants (FRs) and flame retardant substitutes in indoor air, and e-waste dismantling facilities 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-PAs) co-deployed with active low-volume air samplers (LV-VAs). 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), polychlorinated diphenyl ethers (PCDEs) and organophosphate esters (OPEs), using gas chromatography mass spectrometry (GC-MS). The most abundant FRs in air and dust samplers were the novel and banned FRs, including FRs used in e-waste dismantling facility in Southern Ontario, Canada, and to estimate occupational exposure of dismantlers in Southern Ontario, Canada.

**TH245**

**Global approaches to environmental exposure - assessment of e-wastes**

D. Purchase, Middlessex University / Department of Natural Sciences, Faculty of Science and Technology; L. Bisschop, Erasmus University Rotterdam / Department of Criminology; C. Ekberg, Chalmers University of Technology / Division of Energy and Materials, Department of Chemical and Chemical Engineering; P. Fedotov, Russian Academy of Sciences / Vernadsky Institute; H. Garlich, Middlessex University; N. Kandile, Aim Shams University / Department of Chemistry, Faculty of Women; R. Luque, University of Córdoba / Chemistry; O. Popoola, Yaba College of Technology / Department of Chemical Science; H. Ruedel, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; A. Serpe, University of Cagliari / Department of Environmental and Waste Management and Architecture; 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, microplastics, and valuable materials (e.g. gold, silver, copper, palladium, platinum and indium). 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 biomass 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 expertise to explore different aspects of the waste 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 international Union 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 proposed that a harmonised approach should be taken to use appropriate speciation analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.

**TH246**

**Droplets deposition pattern from a prototype of a fixed spraying system in a sloping vineyard**

S. Onto, Italian National Research Council; G. Innernerbe, A. Schmid, C. Roschatt, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE, M. in water, but its true magnitude with absorbance detection is far below than needed. In Italy quality vines are sometimes grown in small fields on steep slopes where spray-gun application of pesticides is used, a technique that is very costly and labor intensive. A possible alternative is the use of a fixed spraying system, and first researches are in progress. A fixed spraying system prototype was built in a vineyard at Laimburg Research Centre and a trial was performed with the aim of measuring the deposition pattern of droplets on the row and between rows with water sensitive papers, also in comparison with a precise low-drift air-blast sprayer. Results show that a fixed spraying system has the potential to apply plant protection products without generating drift problems, with a performance similar to a low-drift sprayer, becoming an opportunity for vineyards on very steep slopes.

**TH247**

**Sensitive Arsenic Speciation by Capillary Electrophoresis Using UV Absorbance Detection with On-Line Sample Preconcentration Techniques**

H. Lee, J. Kwon, Seoul National University; D. Chung, Seoul National University / Chemistry

The World Health Organization (WHO) guideline states that the total arsenic concentration in drinking water must not exceed 10 ppb. However, arsenic toxicity varies significantly, with inorganic arsenic species being more toxic than organic species. Arsenic speciation is therefore important for the evaluation of health risks from arsenic-contaminated drinking water. Capillary electrophoresis (CE) provides the necessary high performance separation for the determination of arsenic species in water samples. CE can be successfully tackled via a multidisciplinary, trans-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 expertise to explore different aspects of the waste 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 international Union 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 proposed that a harmonised approach should be taken to use appropriate speciation analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.

**TH248**

**Determination of background levels of free cyanides in surface waters**


Natural background concentrations of cyanide can originate from the degradation of natural and anthropogenic sources. Recently, environmental quality standards (EQSs) for free cyanide were proposed under the European Water Framework Directive (WFD). The EU Joint Research Centre, for example, has proposed an annual average EQS of 0.5 µg/L free cyanide. Since there is a lack of reliable data on background concentrations of free cyanide in surface waters it is not clear whether the proposed EQS values can be practically implemented. To this end a project was initiated and a method that allows reliable measurements of free cyanide background concentrations in surface waters. Current methods for the measurement of free cyanide in waters only achieve limits of quantifications (LOQs) of about 1

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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 the sampled solution to 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 concentrations between sites, with levels mainly below the limit of detection (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. Ylöstö, H. K. H. van Donk, E. Hausmann, E. Proksch, J. Meyer, E. Finufroeken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, 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 quality monitoring is based on regulatory limits, with levels mostly below the limit of detection (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.

TH250 Improvement of relationship between water pesticide contamination and land used a large scale using the Polar Organic Chemical Integrative Sampler (POCIS) method. S. Freedlander, S. Bremer, H. Kwon, H. Jeon, KIS Core Research Institute, Korea; S. Lissalde, University of Limoges; G. Guibaud, University of Limoges / Research Group on Water Soil and Environment GRESE; S. Bounty, Istrea Bordeaux / UR EABX; M. Saut, J. Rebillard, AEAG Toulouse; N. Mazzella, Istrea Bordeaux / UR EABX. The water quality monitoring of organic micropollutants, is generally 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 hydrophobic organic contaminants, the 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 polytetrafluoroethylene) and a protocol for the preparation of the gel. Then, the choice of the gel was compared with POCIS measurements. 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 in 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 (celullose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.22 μm), finally, we compared the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

TH251 Development and calibration of o-DGT for pesticides, hormones and pharmaceuticals B. Buendia, C. Miège, A. Daval, M. Gregson, Istrea Lyon; N. Mazzella, Istrea Bordeaux / UR EABX. The sampling of micropolllutants 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 hydrophobic organic contaminants. The Polar Organic Chemical Integrative Sampler (POCIS) has already been demonstrated to estimate pesticide loads in small watershed monitoring. Our study aims to show that POCIS provides more reliable and accurate results than the Diffusive Gradient in Thin-film (DGT) for pesticides, hormones and pharmaceuticals. 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 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 (C_{eq,av}) over the full sampling period. PDMS sheets with two different thicknesses (76 and 200 μm) were used as passive samplers to be deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration (C_{in,av}) 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 Elbich 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 and the concentrations were in total including 8 priority substances in EU WFD. C_{eq,av} values can be used as representative values for the comparison with environmental quality standards and C_{eq,av} values can be regarded as variable exposure level. Complementary use of kinetic and equilibrium passive sampler enabled us to comprehensively identify multiple aspect of water quality. Studies on coupling passive sampling with passive dosing mode for risk assessment are ongoing.

TH252 Evaluation of Translocation of [14C]Radiolabeled Plant Protection Product in Tomato Fully Grown in a Greenhouse S. Freedlander, Smiethers Visicient, LLC / Environmental Fate and Metabolism; S. RAO, Gowan Company / Regulatory; K. Malekani, S. Kang, Smithers Visicient / Environmental Fate and Metabolism. Once applied to a plant, pesticide residues have the potential to move to other plant tissues and to consumers of the plant tissues. The objective of this study was to evaluate 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 was treated with a foliar spray and Group 2 was treated with autoradiography by phosphor imager analysis. The TR 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 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 ingredient. A complementary evaluation of translocation during a conventional plant metabolism study can provide valuable information to better 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 viability of the ecosystem. To assess the impact of the OECD 308 Guideline ‘Aerobic and Anaerobic Transformation in Aquatic Sediment Systems’ and the EPA Guideline OCSPF 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 ecosystem.

The hypopharyngeal glands (HPG) of Honeybees consist of many acini connected to the main duct, arranged in the form of long paired cords lying on the both sides of the head. They played important role in many processes because they have a direct connection with the collecting duct, arranged in the form of long paired cords lying on the both sides of the head. They played an important role in maintaining healthy colonies i.e. through production of “milk” containing proteinous substances to feed larvae and queen. The aim of this study was to check the possibility of using scanning electron microscope (SEM) to evaluate the development of hypopharyngeal glands of bees, considering reliability, work-, time-consuming and cost-effectiveness of the method, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Animals were treated with four different chemicals in 4 to 5 concentrations. The left HPG were obtained from 5 different experimental groups and increases of acini and their number per 1 mm² before observation in JEOL JSM-6390LV. The images and linear measurements (small and big axis of symmetry) from ten acini as well as number of acini per 1 mm² were taken from each samples. The analysis of the results showed decreases and increases of acini and their number per 1 mm², depending on the test item, however, these differences were not always statistically significant. It turns-out, that images were very valuable, allowing visual comparison of acini. Data obtained from the studies indicate that SEM can be useful tool for evaluation of hypopharyngeal glands development of Honey bees.

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 to the main duct, arranged in the form of long paired cords lying on the both sides of the head. They played important role in maintaining healthy colonies i.e. through production of “milk” containing proteinous substances to feed larvae and queen. The aim of this study was to check the possibility of using scanning electron microscope (SEM) to evaluate the development of hypopharyngeal glands of bees, considering reliability, work-, time-consuming and cost-effectiveness of the method, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Animals were treated with four different chemicals in 4 to 5 concentrations. The left HPG were obtained from 5 different experimental groups and increases of acini and their number per 1 mm² before observation in JEOL JSM-6390LV. The images and linear measurements (small and big axis of symmetry) from ten acini as well as number of acini per 1 mm² were taken from each samples. The analysis of the results showed decreases and increases of acini and their number per 1 mm², depending on the test item, however, these differences were not always statistically significant. It turns-out, that images were very valuable, allowing visual comparison of acini. Data obtained from the studies indicate that SEM can be useful tool for evaluation of hypopharyngeal glands development of Honey bees.

TH255
Comparison of International Quality Assurance and Quality Control Standards for High Resolution Mass Spectrometry Dioxin Analysis
D. Thal, E. Ogburst, Environmental Standards Inc; R. Vitale, Environmental Standards; 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 have been developed based on the advanced mass spectrometry technology, environment, and the scientifically based standard for recovery correction has 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 identiﬁed 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.

TH256
New Mass Spectrometric Techniques for the Measurement of Persistent Organic Pollutants.
P.D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Giesy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre
Recent development of new mass spectrometry technology 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 that can potentially interfere. The availability of a GC/OrbiTrap system brings levels of mass resolution not previously available for analysis of POPs by GC chromatography coupled with ultra-high resolution mass spectrometry (GC-UHRRMS). Here we report use of GC-UHRRMS for identiﬁcation and quantiﬁcation of PCDD/Fs and PCBs. The methods developed are based on standard US-EPA methods (Methods 1613 and 1668) but are enhanced by use of new capabilites provided by image current detection and high mass resolution (>100,000 FWHM). Robustness of the PCDD/F analyses were demonstrated by excellent calibration characteristics and ability to detect all 2,3,7,8-substituted congeners even in an extract of used motor oil. Reanalysis of fish tissues previously analyzed by a magnetic sector instrument demonstrate accurate and reproducible levels of congeners and quantitations and provide validated levels of the method. Analyses were also conducted to determine the potential for a ‘multiplex’ analysis of various POPs where the resolving power (>120,000 FWHM) of the MS system was able to eliminate potential interferences from a variety of ‘non-target’ organochlorines. These multiplexed analyses significantly reduce the time and cost of sample extract preparation and clean-up. In addition, the relatively simple auto-tuning and mass calibration algorithms available for the advanced mass spectrometry systems greatly simplify these otherwise challenging analyses.

TH257
Influence of water temperature and salinity on impact of Hazardous and Noxious Substances (HNS) in the marine environment
M. Chiovini, D. Doran, D. O’Leary, W. Cooke, University of Sunderland; J. Sheahan, Cefas
It is recognised that Hazardous and Noxious Substances (HNS) transported at sea present a broad range of potential marine spill scenarios due to wide range of fate and effects of the many types transported in bulk through national and international waters. To improve preparedness of response and to provide better advice during marine incidents there is a need to improve our knowledge of the marine hazards/risks associated with the highest priority chemicals. Harbours and ports are typically located in transitional and coastal waters and so ship traffic is more concentrated around these areas and so potential collisions are more likely. These areas are characterised by a range of salinity from 10 - 20 ppt within estuaries up to 34 ppt in coastal and offshore waters. Similarly, seawater temperatures vary significantly and are coupled with seasonal changes. Additionally, seawater temperature and salinity influence the solubility and diffusivity of HNS. Therefore, it is important to consider the influence in seasonal changes and their interaction in the marine environment. This means that chemical spills are likely to have more impact in the summer in ranging sources, an examination of the requirements of these methods was conducted. A review identiﬁed 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
J. D. Quigley; 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. Haro, 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, University of Coimbra; S. Siciliano, University of Saskatchewan / Department of Soil Science; J. Sousa, 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

Using microarthropod community assays in metal mixture testing
A. Renaud; C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. McLaughlin, 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. Bergman, University of Saskatchewan / Department of Soil Science

Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (P)

TH260 Acetylcholinesterase inhibition: a comparison of available methods for determination of acetylcholinesterase in muscle tissue of Limanda limanda.
J. Uzyczak, Centre for Environment, Fisheries and Aquaculture Science (Cefas) / Environment 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) into inactive products. Cholinesterase activity in acetylcholine (ACh) is to regulate the nervous transmission by reducing the concentration of ACh. When AChE is inactivated by an organophosphorous 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/IUCN 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 organophosphorous 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 safety and management of coastal areas. The aim of this project is to produce a consistent and comparable results a model, a mechanistically ba...
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 Folsomia 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 metal contamination. These community dose-response curves allow for the estimation of microarthropod 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, tsh, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. The co-variation of both sgr, gr, gst, at the toxic level of 0.5 mg/L of lead was evidenced in the experiment. The expression profile of ttr, tsh, dio1, dio2, nis, sul1t-s1, sul1t-s2, sul1t-s3, ugt1ab, ugt2al1, 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 both metals were contributing to the oxidative stress balance. No synergistic effects of the two chemicals at short time (48 h) 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
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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 LNs natural cycle have been observed for instance La and Ce in fish species. The adverse effects of LNs on aquatic ecosystems have been observed in many species. 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 cerium (Ce), gadolinium (Gd), and lutetium (Lu), representative of heavy, middle and light LNs, respectively, on seven aquatic species (A. fischeri, R. subcapitata, H. incongruens, D. magna, B. calyciflorus and B. Slootmaekers) that should experience toxic unit calculations based on M(tCd) or M(tHg) or M(tCu). The exceptions to the rule? Metal bioaccumulation in macroinvertebrates (e.g. Biomphalaria glabrata) for bioremediation of heavy metal contaminated environments. However, this situation is not always well studied. Here Leuca gibba was 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 ligand 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 test cases. Fronad number inhibition (%FNI) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [M(tCd)] and external dose [M(tHg)] were also conducted for all chronic tests. Single metal toxicity thresholds were obtained for the three metals, resulting %RGI a more sensitive endpoint than %FNI in all cases. For the test with 0.5 mg DOC/L, Cd presented the higher toxicity, based on 30 %RGI when concentration expressed as M(tCd) (IC25(tCd)max = 29.8 µg/L) being 6 times more toxic than Ni and 30 times than Zn. When concentration expressed as M(tCd)/Cd was also the more toxic metal (IC25(tCd)/Cd = 76.67 µg/g dry weight) being 10 times more toxic than Ni and 26 times than Zn. For the test with 10 mg DOC/L, Ni was the most toxic when dose expressed as M(tCd), but Cd when expressed as M(tCd). At the end of assays, for both DOC concentrations, [Cd(tCd)], [Ni(tCd)] and [Zn(tCd)] 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) toxicity approaches used in this study were evidenced in the experiment. The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, cc, cat, gr, gst), and thyroid-related genes (trt, tsh, dio1, dio2, nis, sul1t-s1, sul1t-s2, sul1t-s3, ugt1ab, ugt2al1, 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 both metals were contributing to the oxidative stress balance. No synergistic effects of the two chemicals at short time (48 h) 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.

TH267
ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA FROM SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA
O. Otojio, 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 expansion of industries. Anthropogenic activities such as mining, coarse agriculture, and deforestation in the 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, Nigeria. Five (5) bacterial isolates were isolated through gram-stain analysis and was used to fit the mixed metal metal toxicity data to either M(tCd) or M(tHg). 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.

TH268
The exceptions to the rule: Metal bioaccumulation in macroinvertebrates from a coastal polluted site
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Surface waters are continuously facing a variety of anthropogenic stressors, including pollution, habitat degradation, and loss of connectivity. In such complex and dynamic environments it is challenging to unambiguously establish the effects of trace metal contamination on the resident organisms. The European Water Framework Directive (WFD) obliges member states to set specific water quality
The aquatic environment is continuously under threat because it is the final receptor of heavy metals and their mixtures on a freshwater fish. Common carp 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 cell line. Of SNPs, one was coated with silver 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, epithelial-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-relative genes (ALG2, BAGAL2T and GNS) expressions. Tested gene expression levels were all suppressed by SNPS and SNCs exposures. Since this study demonstrated that SNPs inhibited glycans synthesis in medaka in vivo and human in vitro models, toxic effects of SNPs on glycans is probably universal among vertebrate organisms.
TH274
Sublethal toxicity of pesticide mixtures on early life stages of non-target aquatic organisms
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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 Arcachon Bay in France. We were focussed on environmentally 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 prototypal (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 metabolitesimetabolites. In conclusion, an indication of a novel mode of action of the chronic toxicity pesticide 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 Vliet, University & Research / Agrosystems Research; 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 model 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 Nethelands. 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 mixtures has been identified by Ctgb (the Board for the Authorisation of Plant Protection Products and Biocides in The Netherlands) 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 metabolitesimetabolites. In conclusion, an indication of a novel mode of action of the chronic toxicity pesticide has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH276
MODELLING ACUTE AND CHRONIC RISKS OF PESTICIDES RESIDUES IN SOUR CHERRIES
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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 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 metabolitesimetabolites. In conclusion, an indication of a novel mode of action of the chronic toxicity pesticide has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH277
Environmental and Human Cumulative Risk Assessment of Pesticides Using Local Monitoring Data: A Case Study from the Pucara River Basin, Bolivia
L. Herrera Noaegida, 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. CederRgreen, University of Copenhagen / Department of Plant and Environmental Sciences

We were focused on environmentally 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 prototypal (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 metabolitesimetabolites. In conclusion, an indication of a novel mode of action of the chronic toxicity pesticide has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.
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 UVCBV 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. Drost, Federal Environment Agency (UBA) / Chemicals

Difficulties arising from the propionate of substances regulated under REACH end up in mixtures. 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 identification of the relevant constituent
to optimize our testing classes of these substances (gums, resinoids, concretes and everything in between)

The main challenges that were identified include the way of data reporting and detailing in ESRs, especially for some critical fields, e.g. endpoint, unit test, 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.

TH280 Natural complex mixtures: Ecotoxic behaviour, what we know and what is next?
R. SAMSEREA, CHEHTRA SAS; N. DELPIT, Laboratoires de Pyrénées et des Landes; P. Bichere, KREATIS; J. Rivera, A. Barret, C. durou, CHEHTRA SAS; P.C. Thirion, CHEHTRA SAS / Ecosystèmes & des

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: monoconstituents, multiconstituents, & UVCBS. Amongst these substance types, several families presenting challenges to testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals fall under multiple categories: natural, synthetic, mononconstituent, multiconstituent or considered as UVCBS. One group of fragrances that fell under the title of multiconstituent/UVCB were known to be particularly difficult to assess: Essential oils (EO). EO are complex mixtures, with differing but often low solubility, high volatility and are known to contain some toxic constituents such as terpenes. We met some even more complex substances in this family: gums, resinoids and concretes, sub-categories of essential oils. They were as complex as EO but their composition was mostly unknown and their physical state leads to further difficulties for ecotoxicity testing: they were (mostly) solutions of extremely viscous resins, with a frozen honey-like texture. We tested hypotheses and performed ecotoxicology and e-fate studies on all the different classes of these substances (gums, resinoids, concretes and everything in between) to optimize our testing strategies for such compounds: we i.e. necessitating avoidance of some using studies of alternative approaches. We will present our hypothesis and overall conclusions on the probable next steps for these complex substances.

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 laboratory. Once the analytical method has been demonstrated, the effect 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-Gatnak, M. Pavan, S-IN Soluzioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

The Product and Organisational Environmental Footprint (PEF and OEF) pilots testing the method and developing Product Category Rules (PCR) 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-TDS0 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 toxicity effect factors (using R-studio) for thousands of chemicals in USEtox. Genotoxicity data was also proposed, based on four quality levels, for studies of the highest quality (key studies, Klimisch 1/2) were included in the first two levels.

TH283 Deriving USEtox aquatic freshwater toxicity Effect factor 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 Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Rivaldom / AMU; D. Neetog, European Commission - Joint Research Studio program

The EFSA 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 EFSA website OpenFoodTox but also accessible via downloadable Excel files. From the OpenFoodTox database, 2695 ecotoxicological observations were

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available for about 451 chemicals. After selecting the appropriate data, species geometric means have been calculated for each taxonomic groups. 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 means 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 risk from food contact materials K. van Gils, Food Packaging Forum Foundation; I. 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 many 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 migrate. 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.

**TH285**
A unique index to characterize the global noxiousness of stable and radioactive substances for both human health and ecosystems K. van Gils, Food Packaging Forum Foundation; I. Muncke, Food Packaging Forum Foundation / General Management

Prompted by methods and tools developed in the field of life cycle analysis (LCA), we hypothesized that it is possible to create a “Chemical Footprint” (ChF) as a single index. According to acknowledged practices in LCIA 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 were likely dissimetrically directly compared in terms of human and ecological noxiousness.

**TH286**
Solution-focused application of mixture modelling and chemical footprints M.C. Zigg, 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, DdZ Ecotox / Centre for Sustainability Environment and Health; D. van de Meeent, 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 100 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 compound (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 is used to result in 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 exists a potential transformation from one to another, i.e., reducing 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, SOKCHO CHUN HYANG UNIVERSITY / Research Institute of Natural Sciences; K. Choi, Seoul National University / Environmental Health Sciences; H. Moon, Hanyang University / Marine Sciences and Convergent Technology The sterols 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 integrated 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 urinary metabolites and exposure levels. Eight basic indexes were commonly computed for DEHP, monoethyl phthalate (MEP), mono(2-ethyl-5-oxo)hexyl phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), mono(2-carboxyethylhexyl) phthalate (MCHEP), and mono(2-ethyl-5-carboxypentyl) phthalate (MCPP) were measured. Among 18 phthalate metabolites, MEHP, MEP, MEHHP, MCPP, MECP, MBzP, MEP, and MBzP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MiPP, MiNP, MEP, and McP were rarely detected in all of the urine samples (<10%). Total concentrations of phthalate metabolites ranged from 3.12 to 6300 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites, Microcystis aeruginosa growth, had the highest concentrations (mean: 63 ng/mL). MiBP (median: 8.4 ng/mL), MnBP (6.8 ng/mL), and MEP (5.2 ng/mL) showed relatively higher concentrations than other phthalate metabolites. Our findings suggest the highest burden of DEHP from multiple sources. In the present study, we defined the peak showing the concentration higher than summation of average and double values of standard deviation as a specific source input associated with phthalate exposure. Tracking the exposure source of phthalates suggests that the major contribution of the phthalates exposure pathways was different depending on chemical properties (e.g., molecular weight) and usage of phthalates. The exposure of lower-molecular-weight phthalates such as DEP and DMP was associated with the consumption of cosmetics and personal care products, whereas the urinary DEHP exposure levels varied with the dietary intake. The present study provides an important information for intervention study to reduce phthalates from humans.
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 exposure data in situ 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 chemical concentrations of emerging concern. Concurrently, at 10 sites, exposures of fathead minnows to stream water were conducted (48h, custom 60K feature microarray platform, liver, NGS based proteome chemistry 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, carbofuran, and triclosan. Some chemicals (triclosan) were indicated by both knowledge-supervised and direct data integration approaches, but isopamid (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 of estrogen receptor signaling. Collectively, and individual toxicities of in situ chemical concentrations of our targeted species. These three health endpoints datasets, and relatively small sample sizes pose challenges for utility of PLS and AR, whereas poorly populated knowledge bases, lack of fish-specific data and poorly characterized in vitro models are problematic for knowledge-based predictions.

TH289

CENTRAL ASIA POLLUTION: OBSELETE TAILINGS, OBSELETE PESTICIDES, OBSELETE GASOLINE AND HUMAN HEALTH DISORDERS

I Hajdambiev, Toxic Action Network Central Asia; Chief Scientific Officer; A. Rospevaa, Asian Medical Institute named Tentshev; V. Didenko, Asian Medical University named Tentshev; I. Kniazev, Asian Medical Institute named Tentshev; B. Hajdambiev, Toxic Action Network Central Asia

We study the radioactive and toxic wasteage health impact: in areas of tailings and obsolete pesticides, and severe air-environment pollution by obsolete gasoline. They all have the same targets - immunity, genetic, endocrine system. The old uranium mining tailings of former USSR military industry in Central Asia (especially in North Tadjikistan (tremendous Degmay)); in Kyrgyzstan – 29 tailings (high concentration in MailiuSu river cost), in Uzbekistan 11 tailings and mines. Total radioactive wastages volume of three CA countries – 700 mln ton. There are 268 warehouses of obsolete pesticides and abandoned airfield used for agro pulverization. These warehouses and tailings could pollute distant areas of CA by infiltration by rivers. Additionally a toxic gas contamination of underground cars. These three health endpoints impacts have common target – immune system and genetic system of human. We made map of most danger areas (it has been using irrigation water and under ground water stream, air condition, etc). After that, real level of pollutants was analyzed: Uranium, DDT-DDE sum - in drinking water and meat; PHB and benzpyrene in air room air. There were used research tools (GIS System programs; Manual: International Chemist Analytic Association; Manual - Disease Mapping and Risk Assessment; etc). Numerous health disorders in (children and pregnant women) of polluted areas were found: abnormal high level of goiter and chronic lung diseases; disorders of immune status in 1,2,3- levels; lower clearance via renal; higher permeability of cell membrane (liver, erythrocytes); leukocytes cytosomal disruption tests. Close correlation between two (or three) toxicant levels and health markers of abnormality was found. Mutual, interconnected impact of different pollutants causes synergetic effect on human’s health marker. We offered results of the research and recommendation for five local and two national governments. Specific actions were: 1) to installing special mark: danger-uranium, or/and DDT, or/and bad air; 2) resettled seventeen families for most danger points; 3) implementing order of pregnancy hospitalize-time would be in comparatively clear 700 mln ton. There are 268 warehouses of obsolete pesticides and abandoned airfield used for agro pulverization. These warehouses and tailings could pollute distant areas of CA by infiltration by rivers. Additionally a toxic gas contamination of underground cars. These three health endpoints impacts have common target – immune system and genetic system of human. We made map of most danger areas (it has been using irrigation water and under ground water stream, air condition, etc). After that, real level of pollutants was analyzed: Uranium, DDT-DDE sum - in drinking water and meat; PHB and benzpyrene in air room air. There were used research tools (GIS System programs; Manual: International Chemist Analytic Association; Manual - Disease Mapping and Risk Assessment; etc). Numerous health disorders in (children and pregnant women) of polluted areas were found: abnormal high level of goiter and chronic lung diseases; disorders of immune status in 1,2,3- levels; lower clearance via renal; higher permeability of cell membrane (liver, erythrocytes); leukocytes cytosomal disruption tests. Close correlation between two (or three) toxicant levels and health markers of abnormality was found. Mutual, interconnected impact of different pollutants causes synergetic effect on human’s health marker. We offered results of the research and recommendation for five local and two national governments. Specific actions were: 1) to installing special mark: danger-uranium, or/and DDT, or/and bad air; 2) resettled seventeen families for most danger points; 3) implementing order of pregnancy hospitalize-time would be in comparatively clear town district.

TH290

Evaluating HPC ingredients in WWTPs & surface water of the Songhua Catchment using monitoring & high tier modelling tools

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Introduction: Ingredients commonly used in home and personal care (HPC) products can enter the aquatic environment after use if they are not completely removed during wastewater treatment. We investigated the occurrence and fate of a range of widespread used ingredients in HPC products in wastewater treatment plants (WWTPs) and surface waters of the Songhua River catchment (China) using a high tier modelling framework and monitoring. The aim of our study was to advance understanding in the occurrence and fate of ingredients found in HPC products in the Songhua catchment, in particular 1) to assess spatial trends in the catchment, and 2) to evaluate and improve modelling predictions. Methods: A monitoring campaign was carried out by I~RC-PTS, in the Songhua catchment (China) undertaken from June-July 2017, sampling WWTPs and watersheds. WWTP influent and effluent samples were collected based on product sales data for China and were input into the modelling framework. The hydrobasins morphometric dataset has been integrated within the Pangea multiscale multimedia modeling framework, using the hydrological flow between each basin and its downstream basin to parameterize the transfer rates from the corresponding water compartments. Results: Initial monitoring results for the Songhua catchment indicate the concentration of HPCs are dominated by LAS in WWTPs and rivers. Modelled influent concentrations show good agreement with measured concentrations for most ingredients, demonstrating emission estimates are reasonable. WWTP median measured removal rates range from 90.6% for TCS up to 99.8% for LAS. In the freshwater compartment there is good agreement, with the model overpredicting concentrations for most ingredients. Conclusion: One combined modelling and monitoring approach is advantageous for assessing exposure, as monitoring data can be used to evaluate model predictions and refine parametrization while modelling provides feedback to improve the representativeness of sampling. This method enables a more detailed analysis of the key sources of uncertainty and variability at each step of the modelling framework (i.e., emission, effluent and river concentrations). Further work to understand the uncertainties in both monitoring and modelling will be carried out in a monitoring campaign in November 2017.

TH291

Mesocosm experiment evidences complex responses of biofilm communities along a gradient of chemical pollution

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Freshwater ecosystems are receivers of chemical pollution, which has been recognized as one of the major causes of river impairment. Wastewater treatment plants (WWTP) are point sources of contaminants in natural receiving waters but information about their effects in the ecosystems is still scarce. Ecosystems are known to react to any environmental change by initiating a series of ecological changes in the receiving body of water. Some of the effects are detrimental (i.e. water quality degradation), whereas others are beneficial. The objective of this study is thus to verify how robust and resilient is an ecosystem to WWTP effluents using a mesocosm experiment which have been revealed as particularly convenient tool to study biological communities’ responses. We exposed twenty-four artificial streams to a range of WWTP effluent concentrations, from no effluent to pure effluent and under controlled conditions of light and water flow during 34 days, followed for 22 days of recovery under no effluent conditions. We analysed river biofilm inhabiting in sediments and cobbles surface because of its major role in ecosystem functioning. To assess impact and recovery we measured Chlorophyll-a content, Chlorophyll-a fluorescence measurements, extracellular enzyme activities (APA and LAP), algal community and metabolism at weekly scale. Pollution load associated to the WWTP effluent was characterized analyzing physical-chemical parameter (pH, dissolved oxygen, conductivity and temperature), nutrients, organic matter, heavy metals and microcontaminants in the water phase. Our preliminary results indicate a complex response of stream ecosystem functioning in front of the WWTP effluent. We notice changes on the system balance and the final return to equilibrium. Acknowledgements - The research leading to these results has received funding from the European Comunities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globaqua

TH292

Risk assessment of chemical mixtures in the Erft river basin

Ankone, North Rhine-Westphalia State Environment Agency (LANUV NRW) / FB 32; U. Rose, M. Trimborn, Erftverband

Mixture toxicity was assessed using extensive chemical monitoring data from the river Erft, its tributaries, and ten municipal waste water treatment plants (WWTPs) discharging into the Erft river basin. Toxic Unit (TU) was used as endpoint assuming concentration addition and using acute toxicity endpoints for algae, macrophytes, daphnia and fish. Substances with high TU as well as the taxonomic groups displaying highest added up TU response (SUM TU) were determined. The chemical inventories of WWTP effluents were analysed to gather information on non-detects i.e. potentially ecotoxically relevant substances which are present in surface waters in concentrations below the analytical limit of detection (LOD). Additionally, single substance risk assessment was performed by determining risk quotients (environmental concentration/ PNEC). Risk quotients larger than one indicate a possible risk for aquatic organisms. SUM TU were mainly

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explained by few compounds which varied between sampling sites and dates (e.g. seasonal use of pesticides). Overall, WWTs increased mixture toxicity in the receiving surface waters. For most samples highest SUM TU could be calculated for macrophytans algae. As a substance highly toxic for algae Triclosan generated high TU. It was detected in nearly all WWT effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be involved in mixture toxicity even at concentrations below LOD. Pesticides often generated high TU but due to the seasonal application substance patterns varied strongly between sampling dates and different locations. Highest pesticide concentrations in surface waters were measured during heavy rainfall which caused run-off from arable land. Single substance risk assessment identified mainly Triclosan, Ibuprofen and Diclofenac as substances with a possible risk for the aquatic organisms. In waterbodies strongly influenced by WWT discharges Diclofenac 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; J.F. Mousinho, University of Aveiro / Department of Biology and CESAM; A.R. Silva, University of Aveiro / Development and Research with Compounds & CESAM; S. Gonzalez, Deltamorfosis and Cremona & 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 in 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 that are 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 natural groundwater composition from the two aquifers. 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 229). The paper aims to elucidate the potential interaction between binary mixtures to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicate 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 Dahllof, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

In laboratory experiments mesozooplankton communities 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 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 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 μmol/L (DBP) and 0.32 μmol/L (DBP), respectively. The interaction of structural endpoints as well as toxic 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

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The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 2300 km 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 impact of such pesticide loads in the marine environment 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 detected at concentrations exceeding 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.

**TH296** Physiological and transcriptomic responses in the tropical coral Stylophora pistillata to inorganic sunscreen exposure

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Between 16000 and 25000 tons of sunscreen are used annually in tropical countries with tourism linked to coral reefs areas considered to be one of fastest growing tourism sector worldwide. Sunscreens are complex mixture of UV filters, emollients, and emulsifiers, and at least 25% of the cream is washed off from the skin during swimming or other daily activities. Concentrations of sunscreen components in a sunscreen formulation and it is independent of the tested sunscreen. Sunscreens may pose a major threat for marine organisms in the shallow water near tourist beaches. Organic UV-filters have been documented to cause bleaching both in adult and larval stages of corals but only few studies have addressed the impact of inorganic sunscreens. A common component of inorganic sunscreen are titanium dioxide nanoparticles (nTiO2) which are widely used as UV-filters in the cosmetic industry due to their transparency and broad spectrum protection along with absence of skin irritation. Results from previous experiments on corals’ symbiotic algae Symbiodinium indicate that sunscreen toxicity is likely driven by the oil components in a sunscreen formulation and it is independent of the tested concentrations of the UV-filter nTiO2 in the cream. Thus in the present study the tropical coral Stylophora pistillata, a common model coral species, was exposed to increasing concentrations of custom-made sunscreen formulations with and without the UV filter nTiO2 to characterize the responses of the chemical mixture either containing or not nanoparticles in it. A series of short-term (5 days) experiments was carried out to compare the effects of these sunscreens on corals, by studying coral photophysiology, coral respiration, symbiont density and chlorophyll content. The expression of genes involved in thermal stress (HSP70), carbon acquisition (intra and extracellular carbonic anhydrase) and calcium and ATP exchange (CA-ATPase) were also analysed to characterize Stylophora pistillata transcriptomic response to sunscreen exposure. Results from this work will be presented and compared to other studies carried out with organic sunscreens. Results from the present studies are essential to understand how the exposure to inorganic sunscreens affects reef-building corals, and they will contribute to the development of effective conservation programs and support eco-tourism.
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 (1-Oct) (80%) and De-n-ethyl ether (DeBE) (20%). These fuels are based on the raw material lignocellulose and -neutral. However, there is no toxic mixture index for environmental contamination, especially for aquatic ecosystems. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction between the two substances. Acute embryotoxic and developmental effects were investigated in the fish embryo toxicity test (FET) with Danio rerio (OECD 216). The acute immobilization assay (OECD 202) was performed to determine the EC50 of this mixture. To interpret the results for possible interactions between the two substances, the mixture of DeBE and 1-Octanol as single substances was necessary. In the acute immobilization test, the EC10 values were 14.7 mg/L for 1-Octanol and 17.3 mg/L for DeBE. Both biofuels led to teratogenic and lethal effects in the FET (LC50: DeBE: 24.7 mg/L; LC50: 11.3 mg/L). Especially in the study of DeBE was a low hatching rate, while embryos were often observed at the pericardium of the developing larva. Testing the mixture in the FET revealed a LC50 of 14.7 mg/L. The acute immobilization test resulted in an 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.

There are many agrochemicals used in agriculture, among them the insecticide abamectin and the fungicide difenoconazole. The mixture toxicity of abamectin and difenoconazole to zebrafish embryos is an EC50 value. The time of exposure in both experiments was 21 days after hatching. We determined the LC50 values of both compounds as a single stressor. In this study we have investigated whether a combination of fungicide (propiconazole) and zinc oxide (ZnO) have different effect on oxidative stress and reproduction of Enchytreus albidus than each of these compounds applied separately. Propiconazole was tested as a commercial formulation and ZnO was tested in a nano and bulk form. In a preliminary experiment an EC50 value for reproduction for each compound was calculated (480 mg/kg ZnO and 40 ug/g PCZ). In the second experiment encytreids were exposed to five concentrations in following ratios: 100% PCZ, 75% PCZ/25% ZnO, 50% PCZ/50% ZnO, 25% PCZ/75% ZnO, 100% ZnO. An EC50 value is an EC50 value. The time of exposure in both experiments was 21 days after which adult encytreids were removed from soil, following another 21 days for juveniles to hatch, according to OECD protocol. Adult encytreids were used for subsequent measurement of biomarkers of oxidative stress (ACHE, CAT, GST) and metallothionen content. The results showed a slightly different response of measured biomarkers to ZnO than to a ZnO + PCZ mixture both in single exposure and when combined with propiconazole as well as the effect on reproduction.

There are many agrochemicals used in agriculture, among them the insecticide abamectin and the fungicide difenoconazole. They are widely used compounds in strawberry crops in regions of tropical climate, although they are compounds classified as extremely toxic and very dangerous to the environment. The use of fish as test organisms stands out in ecotoxicology due to its representativeness and critical role in aquatic environment. Due to ethical issues and to reduce costs, space and waste generated, alternative methods such as assays using fish embryos are currently widely used. The FET - Fish Embryo Toxicity Test is an example of a standardized test that use Danio rerio embryos. Considering the ecological risks.
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 216. The concentrations used were 0.5; 1; 1.2; 2.4; 5.3 and 11.7 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 to combine 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 Minitab program. From the analysis, it was confirmed that the binary mixtures of abamectin and difenoconazole promotes 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. Similar results were obtained with cladocerans and previous studies with Daphnia, represented one exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

Emerging technologies and related raw materials

requirements scenarios: the role of life cycle thinking (P)

Environmental impact assessment of carbon fibers reinforced composites


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 pyrogasification 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 the open source EcoInvent database. CFRCs are highly engineered materials, with high calorific 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 pyrogasification 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 combusion of fumes. Considering the impact assessment results, pyrogasification 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 because of the damage generated by emissions 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 Decre n°36 of 13 January 2003; Implementation of Directive 1999/1/EC on landfill of waste, Official Journal of the Italian Republic, 2003. [2] Legislative Decre 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

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TH306 Environmental sustainability assessment of a biological Active Pharmaceutical Ingredient: A resource based Life Cycle Assessment

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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 adopted to address the task that arises, focussing on 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 (CEEENE) 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

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The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results achieved for 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-octene and p-xylene; From 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 O3 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 scenarios, a simulation of the chemical 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, resident of a significant number of people, and the use of the new LCA allows the evaluation of the environmental weight associated with the entire life cycle of a product, in our case 1 ton of terephthalic acid. The model was validated by the use of SimaPro software and the results indicate that bio-based processes are sustainable only if they use organic residues as raw materials. Both analysis methods used, CED and ReCiPe, have shown that only the alternative way from orange peels has lower environmental impacts than the traditional way from crude oil. For the other processes, the cultivation and transformation of biomass present an environmental weight that does not justify their use as starting materials for p-xylene, and then TA, production. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.

**TH308**

**Environmental assessment of vanadium redox flow batteries**

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The rising production of electric energy from renewable sources requires electrical energy storage systems to compensate for the fluctuations in energy generation. The vanadium redox flow battery (VFB) is a suitable technology for stationary energy storage on a broad scale. Due to the independent scalability of system power and energy capacity, residual of a significant number of people, and the use of the new LCA allows the evaluation of the environmental weight associated with the entire life cycle of a product, in our case 1 ton of terephthalic acid. The model was validated by the use of SimaPro software and the results indicate that bio-based processes are sustainable only if they use organic residues as raw materials. Both analysis methods used, CED and ReCiPe, have shown that only the alternative way from orange peels has lower environmental impacts than the traditional way from crude oil. For the other processes, the cultivation and transformation of biomass present an environmental weight that does not justify their use as starting materials for p-xylene, and then TA, production. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.

**TH309**

Towards the Life Cycle Assessment of engineered nanoparticles production: a comparison between batch and continuous flow synthesis

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The aim of this study is to provide an assessment of continuous micro/milliflow technologies applied to Engineered Nanoparticles (ENPs) production, benchmarking them against the conventional batch productions. As the quantity of ENPs produced and their applications are steeply growing, an increasing attention is being paid to the quality of the product and the efficiency of the synthesis. Continuous micro/milliflow (CF) synthesis is considered to be the natural evolution of the currently most diffused conventional batch synthesis, as it intensifies the production in terms of productivity, energy and chemicals use, product quality and functionalisation. Given the importance and potentiality of the transition, an evaluation of these new technologies is needed. Life Cycle Assessment (LCA) is the chosen methodology for addressing this objective, as it looks deep into the sustainability, efficiency and environmental impact of the system considered, in order to identify the key parameters for a deliberate green process design. The application of the LCA methodology to ENPs production presents many challenges: to date, few LCA studies within the manufacturing process of ENPs have been carried out. In this work, a wide selection of ENPs production is modelled and analysed, and results are compared with those of a state-of-the-art CF technology. The CF syntheses are evaluated on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.

**TH310**

LCA of nanomaterials production for the emerging technology: the case of printing batteries

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BASMATI is an ambitious project which main goal is to develop active nanomaterial and electrochemical inks for printing technologies to transfer and upscale 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 Cycling 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 assessing the potential impacts of Cu, LFP (LiFePO4) 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 ILCD impact assessment method. The 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 assessed for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks compared, 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. A higher impact of LFP inks represents the potential of recycling in the production synthesis. 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.

**TH311**

Life Cycle Assessment (LCA) applied to new and advanced material solutions in Concentrated Solar Thermal technology

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The benefits of high efficiency concentrated solar power (CSP) and photovoltaic (PV) are numerous: environmental protection, zero-carbon process, energy security and economic growth. CSP has advantages in front of PV: possible 24h continuous electricity production, electricity and heat generation, heat for distributed in many challenges: to date, few LCA studies within the manufacturing process of ENPs have been carried out. In this work, a wide selection of ENPs production is modelled and analysed, and results are compared with those of a state-of-the-art CF technology. The CF syntheses are evaluated on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.
High-operating-temperature thermal storage materials for TES 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, developing a design and process looking for high performance but environmentally friendly. Some improvements are being made such as: use of aluminum 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 Eisenerz, Austria. The case of RICAS2020 PROJECT. A. Clare, Leitat Technologic Center / Sustainability Division; G. Ferrer, Leitat Technologic Center / Sustainability Division; J. Ojeda, University of Freiburg / Chair of Societal Transition and Circular Economy; E. Moliné, Depuración de Aguas del Mediterráneo; M. Suárez Ojeda, Technological Center / RD Safety  Sustainability Division; M.R. Riera, LEITAT / Leitat Technologic Center / Sustainability Division / Sustainability Division; A. Claret, Leitat Technologic Center / Sustainability Division; M.R. Riera, LEITAT / Leitat Technologic Center / Sustainability Division. The 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 producon energy has generated a worldwide challenge for 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 considering 3 different storage techniques (in the excavation process: rock, 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. Rifà-Salvés, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology (ICTA); G. Villalba, X. Gabarrull, J. Riera-Adell, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology & Department of Chemical, Biological and Environmental Engineering; E. Moliné, 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 not 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 upgrade consisting in a new wastewater treatment scheme, i.e., (i) a first stage of an enhanced 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-reflecive coating for greenhouse glass. N. Tsou, 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. Technical innovation can contribute to sustainable development but at the same time it can cause unfavorable consequences to environment and society. Environmental assessment of the technologies is usually performed when they have already been launched in the market with a low possibility to transform their development towards better environmental performance. Anticipatory Life Cycle Assessment (LCA) has been evolved to assess the environmental impacts of the novel technologies in the technological innovation phase generating a worldwide challenge for the factory and, thus, the LCA has to evaluate the environmental impacts of the novel coating. 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 greenhouse glass 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. As a result, the coating system 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 and the sensitivity analysis showed that electricity use for the production of glass has higher impacts than emissivity or degradation time of the coatings. The high sensitivity analysis showed that electricity used for the production of glass has higher impacts than emissivity or degradation time of the coatings.

TH315 Combined process simulation analysis with Life Cycle Assessment method in polyurethane rigid foam production. A. Bordignon, M. Ferrugia, 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 computer simulation using algorithmic differential equations that describe 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 polyurethane rigid foam from cradle to grave in tight connection with process simulation methods, thus covering the entire life cycle of the coating production, 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 scenario 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.
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 17α-ethinylestradiol, levonorgestrel and diclofenac, to disrupted Wnt signalling.

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Embryotoxicity testing is a high throughput alternative to using the whole fish model. Previous studies in our laboratory have demonstrated that embryonic exposure to pharmaceutical compounds capable of disrupting the endocrine system such as 17α-ethinylestradiol, levonorgestrel, and diclofenac, both alone and in mixtures, can impair swim bladder inflation of Japanese medaka (Oryzias latipes). Failure of swim bladder inflation can have serious long-term effects on fish population dynamics and steps are being established, compared to the corresponding fish-based route. Furthermore, additional environmental benefits can be obtained from environmentally friendly hydrogen production from photocatalytic water splitting process.

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 / Ecotoxicology and Risk Management; T. Gomes, Norwegian Institute for Water Research; T. Holdway, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science

The laboratory evaluations of the AOPs were performed using UVB and gamma radiation as prototypical oxidative stressors. A network of conceptual AOPs was assembled first and a linear AOP with the strongest data support was then selected prior to WoE assessment using the Evolved Bradford Hill considerations. The laboratory evaluations of the AOPs were performed using UVB and gamma radiations as prototypical oxidative stressors. Daphnia magna was used as the model species. The laboratory studies clearly showed that both UVB and gamma radiation caused dose-dependent reduction in reproduction after the exposure. The reproductive effects were correlated with excess ROS production, lipid peroxidation, DNA damage, apoptosis, mitochondrial DNA deletion, protein and lipid damage, and abnormal ovary 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.

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; P. Lettieri, University College London / Chemical Engineering

Oxidative stress is a common type of stress in living organisms and induced when the production of reactive oxygen species (ROS) overwhelms the endogenous antioxidant defenses. Environmental chemical stressors such as diclofenac, benzene, phenol and their derivatives can cause oxidative stress in aquatic organisms. The aim of this project was to perform a life cycle assessment (LCA) of CO2 utilisation for methanol production systems. CO2-based methanol production has the potential to reduce impacts for global warming and fossil depletion if the corresponding system is based on intermediate reaction and steps are being established, compared to the corresponding fish-based route. Furthermore, additional environmental benefits can be obtained from environmentally friendly hydrogen production from photocatalytic water splitting process.

TH320

Development of an Adverse Outcome Pathway for cardiacmediated toxicity mediated by the blockade of L-type calcium channels

L. Margiotta-Cassabia, H. Dusza, I. Moreira, Brunel University London / Institute of Environment, Health and Societies; M.J. Winter, The University of Exeter / Centre for Environment, Fisheries and Aquaculture Science; H. Prior, National Centre for the Replacement, Refinement and Reduction of Animals in Research (NCR3s)

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-DiC to adverse outcomes in Lemma minor J. Mog, 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 has 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 stressors (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 data by Maximum Likelihood estimation 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 Effectcopedia 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 sacs 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 Cytoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epithelium cell (Beas2B). Beas2B cell was exposed to CMIT/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’ (2017001370001).
**Poster Corner Abstracts**

**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

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In the framework of FP7 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 proteins was studied: tachykinin 3a and tachykinin 3b (involved in neurotransmitter regulation of reproduction), GABA a1 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 a 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 FP7 (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. Miguel, Sao Paulo State University - UNESP / Department of Biology; C.P. de Souza, Sao Paulo State University - UNESP / Biology; J. Evangelista Correia, Unesp - Institute of Biology; C.S. Fontanetti, Sao Paulo State University - UNESP / Biology.

The algal fermentation of sugar cane (Saccharum sp.) results in a by-product known as vinasse. This by-product is used as fertilizer because of its richness in organic matter, and also because it promotes improvement in soil fertility, favoring the availability of some elements for the plants. However, the amount of vinasse used in the fertirrigation should not overcome the ion retention capacity of the soil, since the dosages should be directed to the specific characteristics of each soil. When used in unbalanced proportions can impair to the soils and the plants, in addition to being able to reach water resources. Considering studies that prove the toxicity of vinasse in nature, the use of treatment systems has become quite interesting. The integration of systems such as natural attenuation, filtration and phytoremediation increase the effectiveness of the treatment, since they are highly effective biogeochemical systems to treat wastewater from different sources. Aquatic macrophytes, which not only accumulate pollutants directly in their tissues but also act as catalysts for detoxification reactions that usually, occurs in the rhizosphere of plants, are part of the alternative treatment for vinasse. Fish are excellent experimental models for aquatic toxicity studies because they warn of the potential danger of chemicals reaching water resources. Therefore, this study aimed to verify the efficacy of sugar cane vinasse treatment in reducing its toxic potential by histological and histochemical tests on tilapia gills. The animals were submitted to two different dilutions of the treated vinasse for 96 hours; after this period the gills were removed and submitted to standard histological routine. Morphological analyses of the gills revealed that the cellular pattern described for the species was not altered and histochemical tests showed a decrease on number of mucous cells, thus attesting to the decrease on toxicity of the treated vinasse. Thus, it can be inferred that integrated treatment systems were effective in reducing the polluting potential of vinasse, since the animals did not present histological changes.

**MOPC03**
Assessing toxic effects in the fish Violet Goby (Gobiobranchus broussonneti - Gobiidae) from one of the most productive estuaries in Brazil

I. Salgado, Universidade Federal do Paraná / Farmacologia; A.M. Maques, UFPR / Genetics; F. Garrido de Oliveira, UFPR / Pharmacology; S.L. Moretto, M.M. Cestari, UFPR / Genetics; H. Silva de Assis, UFPR / Pharmacology.

The Assunção-Lagoa dos Patos Estuarine System (São Paulo, Southeast Brazil) is among the most productive areas in the South Atlantic. The Ribeira de Iguape 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 Violet Goby (Gobiobranchus broussonneti - Gobiidae) is a demersal fish of a social and economic importance to traditional fisheries. Over the last decade the regional disappearance of this fish species has been reported, including events of high mortality. The contamination by the RIR has been referred as one of the causes of the decline of that population. Therefore, this study aimed to observe possible toxic effects in G. broussonneti the studied area. Fishes were sampled near Cananéia, Subaúma and Iguape in winter (2016) and summer (2017). The animals were anaesthetized, euthanized and the blood, brain, muscle, liver and kidney were collected for the biochemical and genetic biomarkers analysis. The muscle AChE activities showed similar results among the points and seasons, while cerebral AChE were lower in Subaúma in winter. Hepatic and renal Gpx and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxicity is observed in Subaúma and Iguape liver and blood 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 the contaminants may interfere in the responses. Next generation aneuphotic activity was observed near to Cananéia and Subaúma points. It suggests an influence of the local hydrodynamics by dragging the contaminants of the main sources (RIR and Cananéia city) to these areas once lower impacts were seen in Iguape. This last point is located above the artificial channel in an area of low hydrodynamic. Water and sediment chemical analyzes 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 benthic macroinvertebrates

Y. Mueller, RWTH Aachen University / Department of Ecosystem Analysis ESA; T. Rosenberger, RWTH Aachen University / Institute for Environmental Research BioV; S. Schiwi, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research.

The Neuwasser WWTP, a productive and effective aimed to achieve a good chemical and 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. Beside numerous in vitro and in vivo experiments also in situ experiments were conducted in cooperation with juvenile rainbow trout (Oncorhynchus mykiss) were performed upstream and 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 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, Watchflog S.A.; B.A. Demeneix, MNHN / CNRS UMR 7221; G.F. Lemkine, Watchflog 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 numbers of chemicals, particularly pesticides, have been identified with anti-androgenic activity. 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 spg11 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 mechanisms 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 the androgen activity of a number of pesticides previously identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo in 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 W1
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Viticulture is one of the agricultural domain that uses the most pesticides. Aquatic and terrestrial 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. The aim of this work was to assess 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 (Menanteau, Parodier, Grand Village and Vignolles) and one site Reguignon from Les Souches (a small stream highly impacted by viticulture activity that rejects in La Livenne). Pollutants from 1 L water column had been extracted by SPE (Solid Phase Extraction) method and from sediments had been extracted by elutriates. In the first part of the study, RTL-W1 cells were exposed separately to extracts of water and sediment samples from the three campaigns and different toxicity tests were performed as cytotoxicity (MTT test) and ROS (Reactive Oxygen Species) induction. In the second part of the study, pellets in toluene at high temperatures that was emulsified in water by Tween80 and a biosurfactant obtained from an algae culture). The effect of each confirms 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 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 spg11 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 mechanisms 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 the androgen activity of a number of pesticides previously identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo in 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.

MOPC07
Optimization and Automation of Raman Microspectroscopy for Microplastic Analysis
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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.[1] On the other hand, microplastics (MP) can end up in the environment as a result of bad waste treatment practices and therefore need to be addressed. Raman microspectroscopy (RM) is a versatile tool for MP analytics.[2] Optimization and automation of RM measurements as well as automation of spectral data evaluation are of high importance for monitoring programs and enable quantitative results. We advanced RM-based analysis by optimizing measurement parameters, measurement automation and rapid spectral data evaluation. First, a filter holder was constructed that flattens the filter surface. This filter holder is superior compared to filters deposited on, or glued to, glass slides. However, a flat filter surface is only a first step for successful measurements. For an automated particle recognition we also optimized the contrast between particles and filter. To this end, a variety of polymers (e.g. PE, PP, PS) of different sizes (10^- 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 reflector filters combined with dark field illumination yield superior contrast. Finally, we tested these optimized parameters with samples of different complexity (incl. environmental samples) and three RM methods:- in-situ, semi- and automated in regard of particle recognition and Raman measurements). 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.[3] 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 in-vivo samples, especially for cases were as resulting from seafood.
MOPC09

Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles
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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 and 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 to as microplastic (MP) in a size range from 5 mm to 1 µm. 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, embrittlement of MP-particles, biofouling, and degradation of the MP-particles affect the sorption of humic substances. The composition and structure of humic substances are not yet fully elucidated due to their heterogeneity. Humic substances contain a high number of electron donors, which can interact with many natural and anthropogenic substances. Sediments consist of inorganic and organic components, which pose alternative sorption sites for solved substances. To investigate the effects of humic acids and sediments on the sorption of anthropogenic pollutants, sorption isotherms of i.e. galaxolide to polystyrene (PS) and other synthetic polymers were modelled in presence and absence of humic acids and sediments. A liquid-liquid extraction of the aqueous phase was performed to determine the equilibrium concentrations of galaxolide. A comparison of sorption isotherms regarding the influence of humic acids and sediments was performed to prove or disprove the following hypothesis. (I) Polymer material does 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 majorly 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
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Micropolastics (2µm present on shorelines worldwide). A previous survey of Charleston Harbor, South Carolina, USA reported an average of 591±103 microparticulate particles/m³ 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 main tributaries of Charleston Harbor—the Ashley River, Cooper River, and Wando River—were sampled as intertidal sediments (n=6), subtidal sediment (n=3), 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 (63-500 µm). Intertidal subtidal micropolastic abundance ranged from 3-4375 particles/kg wet weight. Sea surface microlayer micropolastic abundance ranged from 3-36 particles/L. Micropolastic abundance in intertidal sediments and subtidal sediments differed significantly among rivers (p<0.0001 (intertidal), p=0.02 (subtidal)), while micropolastic abundance in the sea surface microlayer did not differ significantly among rivers. Blue micronized rubber fibers and micronized tire rubber were present in the human and non-human types of micropolastics 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 (in the river, bay, and estuary). These results suggest that micropolastics in Charleston Harbor originate primarily from non-point sources and that micropolized 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 micropolastic 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
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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 interdictory project we study the contamination and degradation of marine 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 wildlife 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, bifenthrins, as well as metals were measured to establish the adsorption and leaking 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 pyroGCM/S, GC/MS/MS and LC/HRMS were done in the laboratories of NILU, Tromsø and SINTEF, Trondheim. Exposure to crumb rubber particles may act as a vector for other persistent organic and heavy metal pollutants already present in the marine environment. Furthermore, the rubber particles may act as a vector for other persistent organic and heavy metal pollutants already present in the marine environment. These rubber particles pose a potential health risk for arctic wildlife 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.

MOPC12

Nanoplastics analysis with Nano-FTIR
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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 10^14 particles/m³ for particles with diameters of 0.5 µm. This circumstance raises concerns as particles/animal. With imaging FTIR this is possible only down to particle sizes >10 µm. Electron microscopy suffers from sample instabilities and small aliquot sizes and does not provide the opportunity to simultaneously size and identify plastic samples. Nano-FTIR is a novel technique combining the nanoscale local resolution of AFM imaging with near-field infrared measurements resulting in unprecedented material differentiation on a nanometre level. In our proof-of-principle study, we show measurements with defined nanoscale polymers. To demonstrate the detection of nanoplastics in environmental matrices we analysed samples obtained from arctic sea ice. The Nano-FTIR technique is independent from the source of the sample so that it presents a universal tool for application in the analysis of nanoplastics samples from marine but also all other environments.

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 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 study 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 different deployment periods and grab samples of surface water 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. Thiamethoxam 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. Gin, 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 ECs 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 (CLI), azithromycin (AZT), clarithromycin (CLAR), oxytetracycline (OXY), trimethoprim (TMP), trimethoprim (TMP), and trimethoprim (TMP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), trimethoprim (LIN) and erythromycin (ERY) appeared to be persistent in both the CAS and MBR systems. Field-based monitoring results showed that MBR outperformed CAS in the elimination of most target antibiotics and antimicrobials. The relationship between molecular characteristics of ECs (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], phenoxyl [–O-CH₂], or alkyl groups). Conversely, antibiotics and antimicrobials with the strongest electron withdrawing groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carboxyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC19
The effect of activated sludge conditions on micropollutants biodegradation and transformation products formation

L. Gismonari, G. Buttiglieri, Catalin Institute for Water Research ICRA. Micropollutants 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. Several methods for the monitoring of new contaminants (bio)degradation and especially on transformation products (TPs) is missing. This work aims at achieving a better understanding of the mechanisms and the operative conditions regulating PhACs and EDCs removal as well as TPs formation and degradation in conventional activated sludge (CAS) systems to maximize their biodegradation. Short term (6 hours) experiments were performed to assess the biodegradation of a set of micropollutants and the formation of some of their known TPs in CAS at different pH (7 and 8) and in aerobic and anoxic conditions at a TSS of 1 g/L. Activated sludge was spiked with a mixture of PhACs (100 μg/L) and EDCs (10 μg/L). The best removal of estrone (E1) was obtained under aerobic conditions at pH 8 (80%), while a 60% removal was observed at pH 7. During the first 30 minutes, E1 concentration ranged from 180 to 180 ng/L. However, after 180 minutes, E1 concentration profile drops, suggesting that E2 is oxidized to E1, in consistency with literature. Almost no biodegradation occurred in anoxic batch tests. Estriol was significantly degraded under all conditions. Glucuronides were also monitored, though never detected. EE2 and bisphepho-A were not significantly eliminated in any of the batch tests, though some removal was achieved under aerobic conditions (20 and 15% respectively). However, these derivatives were not detected under anoxic conditions, but proved highly biodegradable under aerobic conditions at both pH 7 and 8, leading to the formation of 2-hydroxysteribuprofen (2-OH-IBU) and carboxyl-ibuprofen (CBX-IBU). 2-OH-IBU concentration increased up to 60% of initial IBU concentration and CBX-IBU concentration raised up to 21% in aerobic batches at pH 7. Metoprolol removal varied from zero (anoxic conditions, pH 7) to 22% of initially spiked concentration (anoxic conditions, pH 8), but its TPs were detected only at negligible concentrations. Sulfamethoxazole (SFX) was not significantly biodegraded by CAS; under aerobic conditions and at pH 7, small amounts of desamino-SFX and acetyl-SFX were produced while 4-nitro SFX was detected at minor concentrations. Venlafaxine and carbamazepine proved to be persistent pharmaceuticals, in consistency with literature.

MOPC20
Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gilt Head Bream

H. Ziarutta, 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 (PIE); A. Prieto, N. Etxebarria, University of the Basque country UPV/EHU / Plantia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; M. Oliva, O. Zuazoa, University of the Basque country UPV/EHU / Plantia Marine Station (PIE-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 aquate 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 biotransformation (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 (BPs) 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 degradations suffered by CIPRO in seawater were oxidation, methylation, oxidative defluorination (in 3 BPs out of 20), reductive defluorination (1 BP out of 20), dehydrogenation of the piperazinyl ring (in 2 BPs) and the cleavage of the lactam 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 piperazinyl 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 gilt-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. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. H. Ziarutta is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

MOPC21
Assessment of the occurrence and impact of polar pesticides in irrigation and drainage ditches at the Ebro River Delta cultivated area (NE Spain)

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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: CTM2016-75877-C2-2-R), and to Merck for the gift of LC columns.

MOPC22
Degradation kinetics and degradation products of diclofenac with persulfate J. M. Montecagudo, University of Castilla-La Mancha; H. El-talawy, Aarhus University / Department of Environmental Science; A. Durán, J. San Martín, University of Castilla-La Mancha; B. Kester, Aarhus University / Environmental Science

Diclofenac concentrations in effluent wastewater are often exceeding local limits or upcoming EU regulations. This study was undertaken to explore the possibilities of removing diclofenac with persulfate in respect to kinetics and reaction pathways. In-situ chemical oxidation of a diclofenac aqueous solution was performed using persulfate anions activated by ultrasound. The diclofenac (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 anion 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 $SO_4^{2-}$ (with no generation of the very effective $SO_3^-$). Sulfate and hydroxyl radicals were involved in the main reaction pathway of diclofenac. Diclofenac amide and three hydroxy-diclofenac isomers (3-hydroxy-diclofenac, 4-hydroxy-diclofenac) were identified as reaction intermediates. The obtained results demonstrated that the US/PS process could be a potential alternative to remove compounds of emerging concern, such as diclofenac from wastewater.

Mercury Biogeoosciences - Fate, Effects and Policy (PC)

MOPC23
Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks

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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 (GTA) in Canada and the Monte Amiata mercury mining district in Italy to illustrate this approach to Hg source characterisation. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radial 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 km$^2$ area covering the former Abbadia San Salvatore mercury mine and a 41.6 km$^2$ 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. 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. Measured 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 significantly higher than at sites presumably distant from potential sources (1.37 ± 0.20 ng m$^{-3}$). In the mine area in Italy concentrations reached as high as 12,500 ng m$^{-3}$ after 34 days and declined rapidly with distance from the most contaminated site. Concentrations were higher in July than in October. At both spatial scales, concentrations declined less steeply towards the East, consistent with prevailing westerly winds. Atmospheric emission from the mine was estimated to range from 50 to 100 kg annually. Clearly, the PAS’s ability to precisely and accurately discriminate small differences in gaseous Hg concentration (< 0.2 ng m$^{-3}$) across a wide range of concentrations, including at and near global background levels, enables the mapping of the spatial concentration variability and the identification, characterisation and quantification of both fugitive and major Hg emission sources.

MOPC24
Mercury trend as a possible result of changes in cod age distribution

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Mercury (Hg) enters the biosphere from natural and anthropogenic sources. Methylmercury is the most toxic form of Hg and has a high bioaccumulative potential, thus high concentrations of Hg may accumulate in fish tissue. Mercury in Atlantic cod (Gadus morhua) is one of many things that are monitored through the Norwegian contribution to the Coordinated Environmental Monitoring Programme (CEMP) carried out by the Norwegian Institute for Water Research (NIVA) by contract from the Norwegian Environment Agency. CEMP is administered by the Oslo and Paris Commissions (OSPAR), and the results from Norway and other OSPAR countries provide a basis for a paramount evaluation of the state of the marine environment. Methylation in the Inner Oslofjord (Norway) reach back to 1984. Until 2014, annual median Hg-concentrations in cod from the Inner Oslofjord displayed significant long-term (whole time series) and short-term (last 10 years) trends (when 2015 was included, the short term trend was not significant). However, the median length of the cod sampled also increased significantly over time. This is consistent with results of beach seine surveys conducted in the Inner Oslofjord the emission of cod recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalised Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from the Inner Oslofjord is dominated by consistent westerly winds. Atmospheric emission from the mine area in Italy to illustrate this approach to Hg source characterisation. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radial 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 km$^2$ area covering the former Abbadia San Salvatore mercury mine and a 41.6 km$^2$ 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. 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. Measured 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 significantly higher than at sites presumably distant from potential sources (1.37 ± 0.20 ng m$^{-3}$). In the mine area in Italy concentrations reached as high as 12,500 ng m$^{-3}$ after 34 days and declined rapidly with distance from the most contaminated site. Concentrations were higher in July than in October. At both spatial scales, concentrations declined less steeply towards the East, consistent with prevailing westerly winds. Atmospheric emission from the mine was estimated to range from 50 to 100 kg annually. Clearly, the PAS’s ability to precisely and accurately discriminate small differences in gaseous Hg concentration (< 0.2 ng m$^{-3}$) across a wide range of concentrations, including at and near global background levels, enables the mapping of the spatial concentration variability and the identification, characterisation and quantification of both fugitive and major Hg emission sources.

MOPC25
Contributions from biomass burning to mercury emissions at Cape Point, South Africa

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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 working in South Africa have been conducted in the Inner Oslofjord the emission of cod recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalised Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from the Inner Oslofjord is dominated by
photodemethylation 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 brownning of freshwaters and further inhibition to the photodemethylation pathway of MeHg reduction.

MOPC27
Polymer inclusion membranes followed by X-ray fluorescence analysis as a novel technology for mercury monitoring in natural waters at low concentration level
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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 this 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 transferred to a sample of Hg reference material of the ICP-OES-ICP-MS (EXDURF) system and were directly analyzed. A good correlation was found when Hg concentration in the natural water (0.5–10 ppb) and the peak area obtained in the analysis of the corresponding loaded PIM, and thus, it can be used as a calibration curve. Optimized conditions of the whole methodology allowed a Hg detection limit of 0.2 ng Hg L⁻¹ in water. Moreover, no water matrix effects were observed when testing tap water, river water, sea water and ground water were found. Thus, PIMs can be seen as a global solution for Hg monitoring in all types of natural waters. Additionally, we have investigated for the first time, the possibility of using PIMs as a tool to preserve samples of Hg in environmental waters. PIMs analyzed after 6 months of Hg extraction did not differ from the results obtained the first day of analysis, and thus, it may be viewed as an innovative media to extract low levels of metal from different natural waters and to preserve sample information until the determination of the metal can be performed.

MOPC28
Dissolved organic matter as a modifier of Hg bioavailability to phytoplankton
V. Fontcuberta, University of Girona / Département F-A. Forel des sciences de l'environnement et de la; T. Chonova, I. Worms, University of Geneva / Department FA Forel for Environmental and Aquatic Sciences
Mercury (Hg) is a priority toxin of global concern, which concentrates in biota and biomagnifies in the aquatic food webs. However, mercury interaction with phytoplankton, central for its incorporation in the food webs, and in particular the role of DOM in modifying mercury partitioning (DOM is still to elucidate. The objective of this work is to get new insight in the role of the DOM on Hg bioavailability to phytoplankton. Since trace metal complexation by DOM is expected to reduce its bioavailability, we hypothesized that the reduction of the Hg bioavailability to Chlamydomonas reinhardtii, chosen as a model phytoplankton, will be proportional to the fraction of the Hg being complexed by DOM. To get insight into the role of DOM in Hg uptake, C. reinhardtii was exposed to two concentrations of Hg in the presence of standard Suwannee River humic acid (SRHA) and in natural water rich in DOM from Onego River. Hg uptake by C. reinhardtii was observed only at 0.7 nM IHg, when the ratio between the reduced sulfur concentration and IHg is higher than 100. A significant increase (1.5x) of Hg uptake in C. reinhardtii exposed to 70 nM Hg in the presence of 0.5 and 5 mg L⁻¹ DOM was found. In the DOM-rich water from lake Onega, a decrease of the bioavailability with respect to exposure in the absence of DOM was found. However no specific trends in the Hg uptake by C. reinhardtii were observed over DOM concentration gradients. The effect of the other factors such as the presence and concentration of different major cations and anions, as well as mercury binding to the Al, Mn and Fe colloids has to be taken into account in addition to the role 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
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. Baudisch, Swedish University of Agricultural Sciences / Department of Agricultural Sciences and Assessment; R. Schaefer, 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 effects for aquatic organism groups (microorganisms, plants, as well as invertebrate and vertebrate animals) with a particular emphasis on the functional and ecosystem level. Related contributions reviewed 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 interactions 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 effects of fungicides are often viewed as an innovative media to extract low levels of metal from different natural waters and to preserve sample information until the determination of the metal can be performed.

TUPC02
Relative tolerance of aquatic organisms to fungicides
A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment TenneT M. Daum, New University of Lyon / Institute for Environmental Sciences
Fungicide compounds are routinely used in intensive agriculture production to treat a wide range of plant pests and microbial pathogens. These compounds may reach aquatic ecosystems by spray-drift, leaching and runoff, posing a potential threat to aquatic organisms. In this study we evaluated the sensitivity and relative tolerance of selected target aquatic organism groups to fungicides by using the standard test species database and complemented with data contained in EFSA draft assessment reports. That contained acute and chronic laboratory toxicity data for 182 taxa and 139 fungicidal compounds. Toxicity data was obtained from the US EPA ECOTOX database and complemented with data contained in EFSA draft assessment reports. The data was selected following strict criteria as regards to the endpoints, measured effect and exposure duration proposed by the EFSA Aquatic Guidance Document for the aquatic effect assessment of plant protection products. Sensitivity differences between non-standard and standard test species were assessed following the relative tolerance (Trel) approach i.e., by dividing the toxicity value of a non-standard test species by the toxicity value of the standard test species. Trel values were calculated on the basis of the standard test species used in the acute first tier tests (Daphnia magna, Oryctolagus mykiss) and chronic first tier (Raphidocelis subcapitata, D. magna, O. mykiss) effect assessments. Trel values were averaged per taxonomic group and per antimicrobial toxic mode of action of the evaluated compounds. The results of this study reveal that, on average, annelids, mysids and bivalves have a higher acute sensitivity to fungicides than D. magna, although such trend was not observed in the chronic sensitivity evaluation. O. mykiss was considered to be among the most sensitive fish species to fungicides. Regarding the primary producer evaluation, diatoms were found to be more sensitive than R. subcapitata in the majority of the cases. Sensitivity differences were generally less than two orders of magnitude in the acute assessment and less than one order of magnitude in the chronic assessment, indicating that the assessment factors applied to toxicity values for standard test species encompass the sensitivity range of non-standard test species. This may not always be the case under the antimicrobial toxic mode of action of the evaluated substances was not identified.
TUPC03 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 Pritsted, 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. Fungiocides 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 fungicide treatment. To mitigate fungicide exposure a range of buffer strips decomposers were set up after a density 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, the vegetation density and erosion rills undermines 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 runoff 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.
TUPC04 Mitigation of fungicide exposure of stream ecosystems within agricultural catchments
M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences
Fungicides are a vital part of the agricultural pest management. As a consequence, fungicides – such as all pesticides – reach surface water bodies mainly through spray drift, runoff or leaching. To mitigate fungicide exposure a range of buffer strips decomposers 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, the vegetation density and erosion rills undermines 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 runoff 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.
TUPC05 Towards a better exposure assessment of antifungal azoles
N. Creusot, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Casado-Hernandez, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; J. Wittmer, Plattform Wasserqualität VSA; K. 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. Stamm, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; A. Thili, Eawag / Department of Environmental Toxicology; M. Casado-Hernández, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences
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. Fungiocides 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 fungicide treatment. To mitigate fungicide exposure a range of buffer strips decomposers have been suggested as a potential measure mitigating fungicide exposure in streams at concentrations that are well below the Regulatory Acceptable Concentrations. Hence, supplemental ecotoxicity tests (e.g. based on aquatic fungi) are probably necessary for sufficiently safeguarding stream ecosystems in the risk assessment of fungicides.
TUPC06 Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems?
M. Dam, 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/mesocosm) approaches. The consistency of this tiered approach has previously been evaluated for invertebrates. 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, semiochemicals 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 I 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 I without requiring any additional study. National decisions for the registration of the product varied, some authorities authorized the use, with any limitations, whereas others demanded up to 30m distance 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 microorganisms 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 possible 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
Eco-toxicological testing and risk assessment considerations for microbial active substances
E.A. McVey, J. Wassenberg, CtgB
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 microorganisms, 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 activity is highly affected by the levels of chemical actives present. 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 more appropriate and adequate testing for microbial active substances.

TUPC09
Historical 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 (SUDD 91/414/EE) strongly promotes a targeted 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 provides a general scope of the data required about microorganisms and 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 more appropriate and adequate testing for microbial active substances.

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 cannot be fully neglected. The assessment of microbial biocontrol agents (mBCA) and microbial biocontrol 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/infecitivity needs to be addressed. Currently, the data requirements for mBCAs and mBCPs are issue of Part 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. e. 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 (formerly 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 may be considered as basis for further discussion in proposing different test designs addressing mBCA and mBCP requirements.

TUPC11
Microbiological Quantiﬁcation Methods for MPCA - Applicability to a Range of Microorganisms and Different Substances
M. Zetzmann, F. Kümmeich, A. Dabrunz, C. Lang, Eurofins Agroscience Ecotons GmbH / Aquatic Ecotoxicology
In the last decade the number of biopesticide registrations in the EU and US have steadily increased. In the EU biopesticides are regulated as plant protection products under regulation 1107/2009. Biopesticides cover a wide spectrum of substances including microbial pest control agents (mPCA) defined as products containing microorganisms (e.g. bacteria, fungi, protozoa, viruses). As for chemical plant protection products, regulatory authorities require an analytical verification of the doses applied in ecotoxicological tests also for mPCAs. Guidance can be derived from SANCO/3030/99 rev.4 and OPPTS 885.1400 (1996), but verification procedures need to be adapted on a case by case basis, as each microorganism possesses its own chemical properties and different growth conditions. Just as chemical methods, microbial methods need to be optimized and validated. Experimental data will be presented with focus on the applicability of microbial quantification methods considering different microorganisms and substrates.

When ecotoxicology meets trophic ecology (PC)
TUPC17
Modelling bioaccumulation of persistent organic pollutants in Arctic food chains
R. Müller, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science; J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science
Persistent organic pollutants (POPs) are a group of chemicals with similar physical-chemical characteristics that are resistant to environmental degradation and biodegradation. Not only do these POPs bioaccumulate in the food chain, they are also known to cause adverse effects in fish, wildlife and humans. Although being banned in the previous century, many POPs are still present in high concentrations in Arctic areas, due to a combination of northward marine currents and their semi-volatile nature, high thermal stability and slow degradation turnover rates. As food webs in the Arctic are relatively simple, POP contamination may pose a great risk for animals at higher trophic levels, such as the polar bear (Ursus maritimus), hence the growing interest in studying bioaccumulation in the Arctic. Despite the large interest in bioaccumulation in Arctic food chains, the OMEGA model, as well as similar bioaccumulation models, are predominately validated on temperate food chains or relatively straightforward Arctic food webs. In the present study, we aim to model bioaccumulation of multiple persistent compounds in the Arctic encompassing multiple species, using the OMEGA (Optimal Modelling for Ecotoxicological Application) bioaccumulation model. In this study, we aim to validate the model on Arctic areas by using a binning approach to include multiple species, in which species of a similar trophic level were binned.

TUPC18
Distribution and Trophic Magnification of Dechloranes, HBCDs, PCNs, and Other Legacy POPs in the Maritime Antarctic Ecosystem
J. Kim, Korea Polar Research Institute / Division of polar paleoenvironment; Y. Choi, POSTECH Pohang University of Science and Technology; M. Barghi, POSTECH; J. Kim, J. Jung, Korea Polar Research Institute; Y. Chang, POSTECH Pohang University of Science and Technology
This study investigated distribution and trophic magnification of emerging persistent organic pollutants (POPs), including PCNs, HBCds, Dechloranes, polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCps) in the maritime ecosystem in King George Island, Antarctica. The samples were collected in the Baton Peninsular in King George Island, Antarctica. From December 2013 to January 2014, and included Antarctic cod, icefish, limpet, amphipods, leopard seal, Gentoo penguin, Chinstrap penguin, kelp gull, and south polar skua, PCNs, HBCds, Dechloranes, DDTs, HCHs, Pentachlorobenzene (PCBz), Hexachlorobenzene (HCBz), Chlorodanes, PCBs were detected in all samples, and the levels were the detection rates for the legacy POPs were more than 90 %, but those of some new POP compounds were only 50%. The detected POP levels in this
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 was 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 TMF values. After the 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 migrant 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 Arctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranates, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranates, 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. Masset, Universite Savoie Mont Blanc; M. Perga, University of Lausanne / Faculty of Geosciences and Environment; N. Cottin, Universite Savoie Mont Blanc; S. Cacher, 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-POP 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 δ13C) and the influence of trophic parameters using δ15N 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 concentrations in both species were not tied to feeding habitats (p>0.05). Trophic position (characterized with δ13C) was also not correlated with intra-species contamination variabilities for the arctic 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<0.01). This last observation could be explained by fish/water partitioning equilibrium to be reached, where fish would tend to accumulate more PCB through their lifetime, highlighting the effect of the bioaccumulation 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.
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Occupying a high trophic level, the white-tailed eagle (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 input consists mainly of fish and seabirds; thus, a long food chain input of nitrogen were used to determine trophic levels and to calculate the trophic magnification factors (TMF) of each compound and its associated metabolism. Our results highlight a trophic dilution (TMF < 1) of all POPs and phthalates, meaning that predators were less contaminated than their prey. The discrepancy in PCB levels between arctic char and whitefish (p=0.002) and whitefish (p<0.01). This last observation could be explained by fish/water partitioning equilibrium to be reached, where fish would tend to accumulate more PCB through their lifetime, highlighting the effect of the bioaccumulation 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.

TUPC21
Fate of PAH, phthalates and their metabolites in an urban river food web.
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Trophic magnification factors have been extensively assessed for persistent 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 the trophic magnification factors (TMF) of each compound and its associated metabolism. 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)

WEPC01
Does pre-exposure to bisphenol A affect the susceptibility of breeding zebrafish upon re-exposure?
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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 methylation 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 0-72μg/L 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 (amb) was significantly downregulated only in fish exposed to BPA for two periods 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
 naïve 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 in 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 and their effects across these effects over 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, mono 2-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 zebrafish, and 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 would lead to the same kind of 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 imply 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?

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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 design. The initial set of experiments revealed that 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 the expression of photosynthesis 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 medium and high radiation levels. The level of total DNA methylation could not be linked to a 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

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This research will utilize environmental reconstruction methods along with paleoecological, paleotemperature, and paleogenomic 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 future potential 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 evolution response to chemical and physical stressors. Future projections of 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 clones of Daphnia to temperature changes in combination with exposure of contaminants. Toxicological assessments 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

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Organisms are rarely exposed to only one single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecking, selection, and altered gene flow. In addition, factors such as altered generation time, or increasing mutation rate. Organic micropollutants such as pesticides, biocides, pharmaceuticals, personal-care products, or industrial chemicals are ubiquitous in the aquatic environment and their effects are considered a relatively new and emerging anthropogenic pressure over evolutionary processes, especially potential effects of pollutants on genetic population structure may be more disruptive regarding ecosystem functioning than individual-level effects. Despite the bunch of investigations on genetic variation in wildlife, our understanding about the individual stressor effects on genetic variation is still limited. Recently, there has been an increased interest to integrate environmental chemistry and evolutionary toxicology approaches into the assessment of direct and indirect effects of stressors, including chemical, physical and anthropogenic pressures on genetic variation. To address these challenges the genetic structure of a shredder invertebrate, Gammarus pulex, was examined using evolutionary toxicology and body burden of organic micropollutant approaches. Exposure to chemical pollution alone and in combination with the presence of weirs. Toxicological assessments 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
What's your take on communication? Don't Panic! Reports on how to accurately communicating science and risk (PC)

WEPC07
Dangers misconceptions - Consumers need help!
U. Klawecka, University of Applied Sciences

Previous surveys revealed that average consumers and even more illiterate persons 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%), homoeopathic products (30%), natural pharmaceticals (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, use, 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

The REACH and CLP regulations are two key regulations addressing the manufacture and use of chemicals and the impact of these chemicals on human health and the environment. Although these regulations do not contain explicit requirements for nanomaterials, the regulations nevertheless address all chemical substances, including nanomaterials. In addition, over the past years, significant reformation on markets and safety aspects of nanomaterials in the EU market. In spite of this, there is a perception that there is insufficient information available in the public regarding the safety of nanomaterials. As a result, the European Commission entrusted ECHA with the creation, management, and maintenance of the European Union Observatory for Nanomaterials (EUON) [1] via a delegation agreement in December 2016[2]. The aim of the Observatory is “to give objective and reliable information on markets and safety aspects of nanomaterials in the EU market”. The present text will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments.
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 environmental impact assessment 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 how to report and to find out which metadata that had the greatest influence on decisions made. The cases represented three choices of ways to produce energy, one between natural gas and waste and heat from waste incineration, one between different vehicle propulsion technologies, 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 most 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. Other mega data have public influence. Then the chapter will discuss how 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. Bidmeier-Fraser, 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 both campuses. The project involved 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 published using modern communication tools such as social media, in tandem with more typical scientific means such as presentations at conferences and colloquia. The results of the study also elicited interest in other disciplines. The collaboration lead to collaborations 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. Osprina-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). Therefore, environmental concerns exist around them and that are increasing its 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 teaching: developing an open online textbook on Environmental Toxicology

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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 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 and each module having a clear training goal/assessment level and flagged 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 of emerging 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 (CRA) programme. The publication as an open access 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)?

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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 and in vitro testing methods are limited by the fact that large, often slow, numbers of animals to deliver confidence in the results. Such recognized shortcomings have led to sub-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
Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WPEC16
SETAC Science and Risk Communication Interest Group
T. Seiler, RWTH Aachen University / Ecosystem Analysis

vitra 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 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.

WPEC17
Biochar-mortar composites for construction materials
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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 Micotest 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.

WPEC18
Complex Formation Trends of Ligand Binding toward In(III) and Ge(IV)
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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. Dwindling 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 chelating agents designed to bind 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 systematic set of chelators with respect to their complex formation energies toward selected In(III) and Ge(IV) complexes. Following afirst 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(II), Fe(III), 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 “Biohydrometallurgical Center for Strategic Elements” BHZM (Nr. 0211205) is gratefully acknowledged.

WPEC19
Cellulose Nanofibers as building blocks for innovative materials for remediation
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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.1,2 We recently report the synthesis of sponge-like nano-structured materials by cross-linking TOCNF and branched polyethyleneimine (bPEI).3 These composites 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 pN320-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective adsorption of fluoro anions.4 Furthermore, the addition of citric acid (CA) as co-crosslinker enhance the mechanical and structural performances.5 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-1) from methanol solution. Interestingly, the presence of CA 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 naproxen).5 It is known regarding the effects to obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (til 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 oceanica, Tetraselmis chui, Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Heliste diversicolor), crustaceans (Acartia tonsa, Artemia salina and Palenca 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 bivalves and echinoderms. 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.

WPEC20
Zn-Al layered double hydroxides: a promising eco-friendly engineered nanomaterial
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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 remarkable properties as anion-exchange materials, non-chemical polymerization, separation and environmental applications based on their swelling, 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 pharmaceuticals for a safe controlled release of drugs. Despite LDH have been regarded as having low toxicity (in nanomaterials),6,7 it is known regarding the effects to obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (til 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 oceanica, Phaeodactylum tricornutum, Tetraselmis chui, Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Heliste diversicolor), crustaceans (Acartia tonsa, Artemia salina and Palenca 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 bivalves and echinoderms. 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.

WPEC21
Studying microfibre release from textiles towards improved clothing design
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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 overlocking the edges to prevent structural shedding. 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 hose connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-weighted filters were allowed to dry to the pre-mass before the release of fibres was determined. The number of fibres was then estimated based on microscopy counting of a pre-weighted 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.

WPEC23 Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)
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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 enhancing on agricultural soil. Due to the relatively low acute toxicity and high natural abundance of silica nanoparticles (SiO$_2$-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 SiO$_2$-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO$_2$-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 SiO$_2$-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 phytostimulant micrometric. The use of silica in nanoagrochemicals promises to reduce the organic pesticide burden of agricultural soil and crops.

WPEC24 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 proponent of the EU pilot on PEF for pasta production. Furthermore, the 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 among pasta producers. The goal is to establish a standard synthetic clothing program, like those of the existing recycled cotton washing programs (1 hr, 40°C). Weights inside the washing machine achieved 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 structural shedding. 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 hose connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-weighted filters were allowed to dry to the pre-mass before the release of fibres was determined. The number of fibres was then estimated based on microscopy counting of a pre-weighted 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.

WPEC25 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 founded 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. In the lower 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.

WPEC26 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. However, 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 factors, that have been shown to contribute to incidence and prevalence of many diseases 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 the example of whole grain consumption. Results show that for individuals under-consuming whole grains (less than 120 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
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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) quantification 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 vastly 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
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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.
Keyword Index

Accumulation.

Aquatic toxicity.

Adsorption.

Atrazine. MO208, MO30

Behavior.

Bioaccumulation.

Biodegradation.

Biomonitoring.

Bioconcentration.

Bioremediation.

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